

TECHNICAL/REQUIREMENTS

DIVISION II - STREETS

II.1 EARTHWORK

II.1.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for all grading, leveling, excavating, embankment construction and other earthmoving work required in street and roadway construction, including disposal of all surplus material.

II.1.B.00 DEFINITIONS

II.1.B.01 UNCLASSIFIED EXCAVATION

Unclassified Excavation is defined as all excavation regardless of the type, nature, or condition of the materials encountered. The Contractor shall assume full responsibility to estimate the kind and extent of various materials to be encountered in order to accomplish the work.

II.1.B.02 CLASSIFIED EXCAVATION

II.1.B.02.1 ROCK EXCAVATION

Rock excavation shall be understood to mean solid sandstone, limestone, granite, basalt or other solid rock of equal hardness, in ledges, bedded deposits, or unstratified masses that, in the Engineer's opinion, will require the use of systematic drilling and blasting or special equipment for removal. Boulders less than one-half cubic yard in volume will not be classified as rock. Cemented gravel (conglomerate), shale, clay, and other sedimentary materials will be classified as rock only when, in the Engineer's opinion, systematic drilling and blasting or special equipment is required for removal. Loam, sand, gravel, clay, or other such material stratified between the layers of rock will not be classified as rock.

II.1.B.02.2 COMMON EXCAVATION

Common excavation is defined as removal of all material not classified as Rock Excavation. Where the type of excavation is not specifically designated, the excavation shall be understood to mean common excavation.

II.1.B.02.3 BORROW EXCAVATION

Borrow material is defined as material obtained from borrow sources lying outside of, separated from, and independent of planned excavation occurring within the project limits.

II.1.B.03 SUBGRADES

Subgrade is defined as the surface area of new or existing roads, streets, alleys, driveways, sidewalks or other places upon which the pavement structure materials are to be placed.

II.1.B.04 UNSUITABLE MATERIALS

Unsuitable materials are those materials which, in the opinion of the Engineer, are unsuitable in their natural state as a subgrade material.

II.1.B.05 OVEREXCAVATION

Overexcavation is defined as the removal of unsuitable material in the bottom of an excavation in preparation for replacement with specified materials. See Section II.2, SUBGRADE STABILIZATION.

II.1.B.06 EMBANKMENT

Embankment is defined as furnishing, placing, and compacting embankment materials to the depth, configuration, and density specified.

II.1.C.00 MATERIALS

II.1.C.01 BORROW AND EMBANKMENT MATERIALS

The Contractor shall provide borrow and embankment materials of approved earth, sand, gravel or rock, or combinations thereof, free of peat, humus, muck, frozen ground, organic matter or other materials detrimental to the construction of firm, dense, and sound embankments.

The Contractor shall use all approved materials originating from the required excavation as far as practicable in the formation of embankments and subgrade, and for other work as shown or directed.

II.1.C.02 WATER

Water used in all work must be reasonably clean and free of oil, salts, acid, alkali, sugar, vegetative matter, silts, and any other substances which would be deleterious to the quality of the material to which it is applied or with which it is mixed. Whenever City water is to be used, the Contractor shall obtain a hydrant meter from the City Public Works Department.

II.1.C.03 EXPLOSIVES

Explosives are to be fresh, stable materials manufactured to the standards of the "Institute of Makers of Explosives", and shall conform to the applicable requirement of ORS Chapters 476 and 480.

II.1.D.00 CONSTRUCTION/WORKMANSHIP

II.1.D.01 PRESERVATION OF EXISTING IMPROVEMENTS

The Contractor shall conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other facilities, which are to remain in place will not be damaged. The Contractor shall furnish and install cribbing and shoring or whatever means necessary to support material carrying existing facilities, or to support the facilities themselves, and to maintain such supports until no longer needed.

The Contractor shall protect temporary pavements, facilities, utilities, and installations until they are no longer required. When temporary supports and other protective means are no longer required, the Contractor shall remove and dispose of as directed.

The Contractor shall notify the Engineer immediately upon the discovery by the Contractor of any existing utilities of whose existence or location had previously been unknown. These utilities include, but are not limited to, sewer service laterals, storm drain laterals, roof drains below curb level, drain tiles, water services, etc. The Engineer shall then examine the situation and make a decision as to hook up, abandonment, or other. If a bid item exists for the work required, the work shall be paid for under the bid item. If no bid item exists for the work required, the Engineer shall negotiate with the Contractor for an equitable price. Failure of the Contractor to immediately notify the Engineer of existing utilities shall in no way relieve the Contractor of his responsibility to notify the Engineer of the situation and to have the Engineer make a decision concerning the situation.

Any damage to existing improvements which are to remain in place shall be the responsibility of the Contractor. The Contractor shall repair or replace the damaged improvements at the direction of the Engineer all at the cost of the Contractor.

II.1.D.02 EXCAVATION

II.1.D.02.01 EXCAVATION OF EXISTING IMPROVEMENTS

Unless otherwise specifically provided, excavation includes all excavating, removing, hauling and depositing of, including but not limited to existing pavements, walks, drive-ways, surfacing, slabs, curbs, gutters and similar concrete structures, bituminous materials, all rock or gravel road surfacing materials, abandoned sewers, pipe and conduits, logs, piling, footings, foundations, vaults and chambers, when such materials are within the limits of excavation. The volumes of such items from within the excavation limits shown will be included in the excavation quantities.

The Contractor shall remove the remaining ends of abandoned pipes, or portions of other items partially removed under this work, which would be left exposed after final excavation, to within a minimum of 1-foot of the finished slope or subgrade. The Contractor shall plug or seal the abandoned pipes as approved by the Engineer.

II.1.D.02.2 LIMITS OF EXCAVATION

The Contractor shall excavate to the depths and widths as shown on the

Plans and/or as designated by the Engineer, allowing for forms, shoring, working space, gravel base, and finish topsoil where required.

Where the limits of excavation abut against existing pavements, the existing pavement shall be saw cut on the line specified, or as directed by the Engineer, prior to the placement of new pavement abutting the existing. Cuts shall be clean and vertical and within a tolerance of 0.1-foot.

The subgrade shall be excavated to a tolerance of 0.1-foot of that grade specified in the Plans or by the Engineer. The Contractor shall not excavate below the subgrade without prior approval by the Engineer. Any excavation below subgrade not specifically approved by the Engineer shall be brought to grade with approved compacted gravel; the cost of such work and materials to be borne solely by the Contractor.

II.1.D.02.3 UNCLASSIFIED EXCAVATION

The Contractor shall excavate, remove, and dispose of all formations and materials, natural or man-made, irrespective of nature or conditions, encountered within the excavation limits, excepting those items as specified in Section II.1.D.01, PRESERVATION OF EXISTING IMPROVEMENTS.

II.1.D.02.4 ROCK EXCAVATION

Rock excavation shall be confined to those areas as specified in Section II.1.B.02.1, ROCK EXCAVATION, and shall be in accordance with the required excavation limits as specified in Section II.1.D.02.2, LIMITS OF EXCAVATION.

Before rock removal by systematic drilling and blasting or other methods will be permitted, the material shall be exposed by removing the common material above it or by predrilling. The Contractor shall keep a drilling log for each hole drilled that shall include the location of the drill hole and relative elevation and type of the rock or other materials drilled. The Engineer shall then be notified, after which the Engineer, with the help of the Contractor, will measure the amount of material to be removed and will record the information.

If systematic drilling and blasting is to be used, the Contractor shall secure a City blasting permit and shall comply with all provisions of said permit.

The use and security of the explosives shall be in conformance with the applicable provisions of General Requirements Section II.07, LEGAL RESPONSIBILITIES. The Contractor shall be responsible for any and all damage to below surface, surface, and/or above surface and/or any injury to persons resulting from the blasting, or accidental or premature explosions that may occur in connection with the use of the explosives. Adequate warning to all affected persons shall always be given. Procedures, safety precautions, and times of blasting shall be submitted to the Engineer for approval prior to blasting.

All explosives used shall be in conformance with Section II.1.C.03, EXPLOSIVES.

II.1.D.02.5 COMMON EXCAVATION

The Contractor shall excavate, remove, and dispose of all formations and materials, natural or man-made, irrespective of nature or conditions, encountered within the excavation limits, excepting those items as specified in Section II.1.D.02.4, ROCK EXCAVATION, and Section II.1.D.01, PRESERVATION OF EXISTING IMPROVEMENTS.

II.1.D.03 DISPOSAL OF EXCESS MATERIAL

All excavated materials not suitable or not required for embankment as directed by the Engineer, unless otherwise specified, shall be removed from the project site and shall be disposed of by the Contractor in a manner satisfactory to the Engineer and in compliance with Federal, State and local laws and ordinances. The Contractor shall obtain all necessary permits from the proper agencies prior to any filling offsite. Unless otherwise specified the material will become the property of the Contractor.

II.1.D.04 EMBANKMENT

Prior to construction of any embankments, the natural ground underlying the embankment shall be compacted to the density specified. Any unstable or unsuitable material shall be excavated and disposed of as directed.

Embankment materials shall be in conformance with Section II.1.C.01, BORROW AND EMBANKMENT MATERIALS. When rock is to be included as an embankment material, the largest rock size allowed shall be 6-inches, and the rock material shall not exceed 10% of the total embankment material volume.

The Contractor shall place embankments in approximate horizontal lifts of appropriate thickness, as determined by the Engineer, for the type of equipment being used to compact each lift separately and thoroughly to 95% of its maximum relative density according to AASHTO T99 or as otherwise specified.

In the immediate vicinity of curbs, walks, driveways, inlets, manholes and similar structures, in holes, and where embankment materials cannot be reached by normal compacting methods, the Contractor shall compact to the density specified by using other approved methods.

The Contractor shall exercise precaution to insure that embankment construction does not move, endanger, or overstress any structure. Embankments at the end of bridges shall be placed and compacted prior to the time that work begins on the bridge.

Embankments shall not be constructed when the embankment material, the foundation, or the embankment on which it would be placed is frozen.

The embankment shall be placed to a tolerance of 0.1-foot of that grade specified in the Plans or by the Engineer.

II.1.D.05 SUBGRADE

II.1.D.05.1 COMPACTION AND DENSITY REQUIREMENTS

The density and moisture content required of compacted materials in place shall be a percentage of the maximum density and optimum moisture as determined by AASHTO T99.

Preliminary soil samples shall be taken by the Engineer for testing under AASHTO T99 at the minimum rate of one sample per 500 lineal feet of roadway and when the soil type noticeably changes. The maximum relative density obtained from the test for each sample shall be the basis for acceptance or rejection when testing in each respective area.

All materials within 12-inches of the established subgrade elevation shall be compacted to a minimum density in place of 95% of the maximum relative density, unless otherwise specified.

Roadbed cuts and foundations for structures to a depth of 1-foot below established subgrade or foundation elevation shall be 3-inches maximum material and compacted until no reaction or yielding is observed under the compactor.

II.1.D.05.2 WATERING OF MATERIALS

The watering of materials to provide compaction, required density and optimum moisture to the subgrade and to alleviate dust nuisance, shall be performed as authorized and directed by the Engineer. The water shall be in conformance with Section II.1.C.02, WATER.

When in the opinion of the Engineer, the addition of water to the subgrade and/or to areas below the subgrade, such as trench backfill, will be harmful to the subgrade, water will not be allowed.

II.1.D.05.3 REMOVAL OF EXCESS MOISTURE

The subgrade will not be accepted until moisture in excess of optimum moisture has been removed therefrom. Removal of excess moisture may be by aeration, drainage, rehandling or other means at the option of the Contractor at no expense to the City. The time involved for the removal of excess moisture shall in no way be a reason for the extension of the contract time.

II.1.D.05.4 UNSUITABLE MATERIAL

In the event that material exists in the subgrade which, in the opinion of the Engineer, is unsuitable as a subgrade material, or is a material which cannot be compacted to the specified density using normal methods, as outlined in Section II.1.D.05.2, WATERING OF MATERIALS, and II.1.D.05.3, REMOVAL OF EXCESS MOISTURE, the Contractor shall perform some method of subgrade stabilization as specified in Section II.2, SUBGRADE STABILIZATION, and as directed by the Engineer.

II.1.D.06 FINISHING ROADBEDS AND SLOPES

The Contractor shall trim all roadbeds, ditches, cutbanks, and other excavations and embankments reasonably close to the established lines, grades, and cross-sections as shown on the Plans and/or as directed by the Engineer.

Holes resulting from grubbing and removal work, basements trenches, etc., which lie outside of the limits of required excavation or embankment construction shall be backfilled with suitable embankment materials, and smoothed and shaped to blend with the surrounding area.

After the main excavation in rock or rocky cuts is completed, the Contractor shall test slopes of the cuts thoroughly with bars, or by other approved means, and remove all loose, detached, broken, or otherwise unstable material. The Contractor shall remove jutting points and bring the entire cut slope area to a safe, trim and neat condition. The Contractor shall dispose of the materials removed under this provision in the same manner as other excavated material.

The Contractor shall leave all surface features in a neat and well-finished condition, as approved by the Engineer, prior to the time the project is completed and accepted.

II.1.E.00 TESTING

II.1.E.01 COMPACTION AND DENSITY

Unless otherwise directed by the Engineer, the specified density and moisture content requirements as determined by AASHTO T99 shall be tested by the Engineer using a nuclear density - moisture gauge prior to subgrade approval.

In the event that, in the opinion of the Engineer, the subgrade is composed of materials which are not suitable for testing using the nuclear density-moisture gauge, then the compaction of the subgrade shall be determined on a deflection basis. The compacted material in place shall show no appreciable deflection reaction under a loaded truck with a gross weight of 20 tons, as approved by the Engineer. The Contractor shall supply the equipment as specified and the subgrade shall meet the above requirements prior to subgrade approval; the cost of such work and equipment to be borne solely by the Contractor.

II.1.E.02 LINE AND GRADE

The specified line and grade shall be checked by the Engineer using levels, tapes, string lines, and/or other appropriate methods prior to final subgrade approval.

II.1.F.00 MEASUREMENT AND PAYMENT

II.1.F.01 MEASUREMENT

II.1.F.01.1 UNCLASSIFIED AND COMMON EXCAVATION

Quantities for unclassified and common excavation work will be measured on a cubic yard basis in original position prior to excavation and shall be based on quantities computed from the plotted cross-sections determined from the construction surveys. The quantity

measured for payment will include only material excavated from within the specified excavation limits. Any additional excavation outside of these limits, unless specifically authorized by the Engineer, shall be considered as having been made for the Contractor's benefit and will be considered as incidental to the work.

II.1.F.01.2 ROCK EXCAVATION

Quantities for rock excavation will be measured on a cubic yard basis to the nearest 0.25 cubic yard in original position prior to excavation and shall be based on profile and cross-sectional measurements to the nearest 0.1-foot. The quantity measured for payment will include only material excavated from within the specified excavation limits. Any additional excavation outside of these limits, unless specifically authorized by the Engineer, shall be considered as having been made for the Contractor's benefit and shall be considered as incidental. The quantities as established for payment must be approved by the Engineer.

II.1.F.01.3 BORROW EXCAVATION

When specified, quantities for borrow material will be measured on a cubic yard basis. The measurement will be based on cross-sections of compacted material in place in the designated embankment areas and to the lines and grades as specified for embankment.

When specified, quantities for borrow material will be measured on a ton basis. Material receipts showing certified scale weights will be required from the Contractor.

II.1.F.01.4 EMBANKMENT IN PLACE

Quantities for embankment in place will be measured on a cubic yard basis. The measurement will be based on cross sections of the original ground in the designated embankment areas and to the lines and grades as specified for embankment. The pay quantities will not include additional quantities required due to subsidence and settlement of the ground or foundation, to settlement of materials within the embankment, or to shrinkage, settlement, washout, slippage or loss regardless of cause, except in the case of a phenomenon of nature of catastrophic proportions or intensity such as an earthquake, flood, tornado, or hurricane.

II.1.F.02 PAYMENT

II.1.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to earthwork performed on the contract work under Section II.1, EARTHWORK, by reason of Special Provisions, shall be understood to comprise full and completed compensation for all labor, equipment, tools, materials, and incidentals necessary for all the contract work as specified for performance under or covered by this Section.

The pay items shall comprise full compensation for, but not limited to, excavating, selecting, handling, sorting, placing and compacting of the materials and the haul involved.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

II.1.F.02.2 PAY ITEMS

Pay Item Description	Unit of Measure
Unclassified Excavation	Cubic Yards
Rock Excavation	Cubic Yards
Common Excavation	Cubic Yards
Borrow Excavation	Cubic Yards or Tons
Embankment in Place	Cubic Yards

II.2 SUBGRADE STABILIZATION

II.2.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for preparation of the subgrade when, in the opinion of the Engineer, portions of the subgrade are composed of materials which in their natural state are unsuitable for subgrade construction.

II.2.B.00 DEFINITIONS

II.2.B.01 SUBGRADE

Subgrade is defined as the surface area of new or existing roads, streets, alleys, driveways, sidewalks, or other places upon which the pavement structure materials are to be placed.

II.2.B.02 UNTREATED SUBGRADE

Untreated subgrade is defined as that subgrade which has not had a chemical stabilizer added to it.

II.2.B.03 TREATED SUBGRADE

Treated subgrade is defined as that subgrade which has had a chemical stabilizer added to it.

II.2.B.04 UNSUITABLE MATERIALS

Unsuitable materials are those materials which in the opinion of the Engineer, are unsuitable in their natural state as a subgrade material.

II.2.B.05 OVEREXCAVATION

Overexcavation is defined as the removal of unsuitable material in the bottom of an excavation in preparation for replacement with specified materials.

II.2.C.00 MATERIALS

II.2.C.01 SOIL STABILIZING MATERIALS

MATERIAL	TYPE	GRADE
Hydrated Lime	AASHTO M216, Type 1	Grade A
Granular Quicklime	AASHTO T27 and T219 for grading and hydroxide content, with minimum 85% Calcium Hydroxide	100% passing 3/8-inch sieve, maximum 15% passing 100 sieve
PCC	AASHTO M85	Conform to PCC in Section II.5.C.01

II.2.C.02 AGGREGATE

- 1) Approved Quarry Rock - 3-inch largest material allowed
- 2) Other aggregate material as specifically approved and directed by the Engineer.

II.2.C.03 FABRIC

As a minimum, the following fabrics may be used.

- 1) Dupont "Tytar"
- 2) Phillips "Supac 5-P"
- 3) Monsanto "Bidim C22"
- 4) An Approved Equal

II.2.C.04 WATER

Water used in all work must be reasonably clean and free of oil, salts, acid, alkali, sugar, vegetative matter, silts, and any other substance which would be deleterious to the quality of the material to which it is applied or with which it is mixed. Whenever City water is to be used, the Contractor shall obtain a hydrant meter from the City Public Works Department.

II.2.C.05 BITUMINOUS MATERIAL

The asphalt for the bituminous curing seal shall be a rapid setting emulsified asphalt conforming to the applicable requirements of AASHTO M140 or AASHTO M208 and as directed by the Engineer.

II.2.D.00 CONSTRUCTION/WORKMANSHIP

II.2.D.01 CHEMICAL SOIL STABILIZATION

II.2.D.01.1 GENERAL

When specified or directed by the Engineer chemical soil stabilization shall be used as a method for subgrade stabilization. The upper layer of the subgrade to be treated shall be compacted to the density specified and shall be finished to the established lines and grades prior to the application of the stabilizing material. At the Contractor's option, the subgrade material may be loosened by scarifying and/or by adding moisture to the depth to be treated prior to application of the stabilizing material.

The Contractor shall dry and reduce the cemented soil clods to the moisture content and size specified. The Contractor shall shape and size the subgrade material blanket to the size that can pass through the mixing machine. Stabilizing materials shall be applied only when the temperature is above freezing, and when the wind and other weather conditions are not detrimental to the work or to the public as approved.

The Contractor shall take all precautions necessary to prevent injury to persons, domestic animals, livestock or property. Any material which is spilled or deposited at places other than areas designated to be treated shall be immediately picked up, buried, or otherwise made harmless at the direction of the Engineer and at the expense of the Contractor.

II.2.D.01.2 ADDITION OF STABILIZING MATERIAL

The Contractor shall apply the stabilizer as approved by the Engineer at a uniform rate as specified. Equipment and methods shall be used that will insure the uniformity of the stabilizer distribution. The Contractor shall immediately discontinue the use of any equipment or method which results in the excessive loss or displacement of the stabilizer. Any stabilizer which is lost, displaced by blowing, washing, or misplaced by other causes before it is mixed with or incorporated in the soil, shall be replaced at no additional expense to the City.

No equipment except that used for watering and for applying and mixing the stabilizer material will be permitted to pass over spread stabilizer material until after it is mixed into the soil. If necessary, water shall be added during mixing operations to provide an optimum moisture content.

II.2.D.01.3 MIXING

The Contractor shall spread the soil stabilizing material on a subgrade with approved equipment which uniformly distributes the required amount of material for the full width of the prepared subgrade. The Contractor shall continue mixing or remixing operations until the mixture is uniform, free of streaks or pockets of soil stabilizing material, and until all material other than stones will pass a 2-inch sieve and at least 60% will pass a No. 4 sieve.

II.2.D.01.4 COMPACTION

Immediately after the mixing of the stabilizer has been completed, the mixture shall be spread to the specified line, grade, and cross section and the entire depth of the mixture shall be compacted to a density of not less than 95% of the maximum relative density as determined by AASHTO T99.

This compaction shall be attained and the surface brought to finished condition within 12 hours after the compaction begins; otherwise, the mixture shall be loosened and additional stabilizing material and water shall be added as directed. The freshened materials shall be remixed, relaid and recompactd. The cost of the extra materials and labor shall be borne solely by the Contractor.

During the compacting, the surface of the mixture shall be maintained at proper grade and cross section and shall be lightly watered to retain optimum moisture content. The Contractor shall accomplish final finishing by rolling accompanied by light watering and reshaping as required.

II.2.D.01.5 TOLERANCES

The Contractor shall rework areas found to be deficient in thickness by more than 0.04-foot or excessive in thickness by more than 0.08-foot, as specified in Section II.2.E.01.1, THICKNESS, except that the stabilizing material shall be added in an amount equal to ½ of the specified original amount.

The finished surface of the treated or untreated subgrade shall not vary more than 0.04-foot from established grade and cross section at any point. These areas shall be reworked as specified above and as directed by the Engineer.

The Contractor shall accomplish all reworking at no expense to the City.

II.2.D.01.6 CURING AND PROTECTION

The finished surface shall be kept moist and protected from rutting, spalling, displacement and disfiguration for a period of 7 days or until a subsequent course of planned construction which will prevent drying of the mixture by evaporation or absorption is placed thereon, unless otherwise directed.

When directed by the Engineer, a bituminous curing seal shall be used. As soon as possible after the surface of the treated subgrade is finished, the surface and exposed edges shall be covered with a bituminous curing seal. The liquid asphalt shall be applied by a pressure spray method and at a rate necessary to provide a continuous, unbroken curing membrane. In case of damage to the curing seal, after application and during the curing period, the damaged section shall be repaired by the Contractor immediately and at his own expense.

Traffic over the completed treated subgrade shall be limited to wheel loads which do not cause any visible deflection of the surfaces, and which do not rut, ravel or wear the surface in any way. Damaged to the finished treatment will be cause for reworking the treatment and for restoration thereof to the specified construction requirements.

II.2.D.02 OVEREXCAVATION

When specified or directed by the Engineer, overexcavation shall be used as a method for subgrade stabilization.

Localized areas of unsuitable subgrade material shall be overexcavated to the line and grade as directed by the Engineer. The overexcavated areas shall be backfilled with approved aggregate materials as specified by the Engineer and compacted to the extent as directed by the Engineer. The compacted material shall be brought to the line and grade of the subgrade as specified.

The overexcavation shall be to a tolerance of 0.1-foot of the grade as directed by the Engineer. Any overexcavation not specifically approved by the Engineer shall be brought to the specified grade with approved aggregate materials; the cost of such work and materials to be borne solely by the Contractor.

II.2.D.03 STABILIZATION WITH FABRIC

When specified or directed by the Engineer, fabric shall be used as a method for subgrade stabilization.

Before placing of the fabric, the subgrade shall be finished to a point where all ruts, grooves or other surface irregularities are filled in and smoothed out as directed by the Engineer. The Contractor shall roll out the fabric in the direction of the roadway, laying the fabric directly on the soil. The fabric shall be spread uniformly over the subgrade surface to the limits as specified and as directed by the Engineer. For areas greater than the fabric width or length, several widths or lengths of fabric shall be overlapped. The overlap shall be a minimum of 18-inches, except that a greater overlap shall be required, as directed by the Engineer, when very poor soil conditions exist.

No vehicles, including construction equipment, shall be allowed directly on the fabric. Aggregate base material shall be placed on the fabric in such a manner that the construction equipment will be on the aggregate and not directly on the fabric.

Any damage to the fabric shall be repaired by the Contractor by patching with the same type of fabric and overlapping past the damaged area a minimum of 18-inches, as directed by the Engineer. All repair costs shall be borne solely by the Contractor.

II.2.E.00 TESTING

II.2.E.01 CHEMICAL SOIL STABILIZATION

II.2.E.01.1 THICKNESS

The thickness of the completed treated subgrade will be subject to determination by the Engineer from measurements in holes drilled or dug by him in the finished work at locations of his selection.

II.2.E.01.2 GRADE AND CROSS-SECTION

The finished surface grade and cross-section shall be checked by the Engineer using hand levels, tapes, string lines, straight edges and/or other appropriate methods prior to the final subgrade approval.

II.2.E.01.3 COMPACTION AND DENSITY

Unless otherwise directed by the Engineer, the specified density and moisture requirements as determined by AASHTO T99 shall be tested by the Engineer using a nuclear density-moisture gauge prior to final subgrade approval.

When directed by the Engineer, the compaction of the treated subgrade shall be determined on a deflection basis. This test shall be made after the treated subgrade has "setup". The compacted material in place shall show no appreciable deflection or reaction under a loaded truck with a gross weight of 20 tons as determined by the Engineer. The Contractor shall supply the equipment as specified and the subgrade shall meet the above requirements prior to subgrade approval; the cost of such work and equipment to be borne solely by the Contractor.

II.2.E.02 OVEREXCAVATION

II.2.E.02.1 COMPACTION

The compaction of the aggregate material that was placed during the overexcavation operation shall be tested using a deflection basis as described in Section II.2.E.01.3, COMPACTION AND DENSITY.

II.2.E.02.2 GRADE AND CROSS-SECTION

The checking of the finished surface grade and cross section shall conform to the requirements of Section II.2.E.01.2, GRADE AND CROSS-SECTION.

II.2.F.00 MEASUREMENT AND PAYMENT

II.2.F.01 MEASUREMENT

II.2.F.01.1 CHEMICAL SOIL STABILIZATION

The quantity of stabilizing material to be paid for shall be measured by the ton, dry weight, to the nearest 0.01 ton, and shall include the materials incorporated in the work up to the quantity and treatment volume derived from the specified rate or directed by the Engineer. Measurement and payment of stabilizing materials will not include any which are lost, displaced, used in reworking, used in restoration work or used contrary to that specified or the direction of the Engineer. Packaged materials will be accepted at the net weight shown by the manufacturer subject to periodic verification and approval by the Engineer. The Contractor shall provide a certificate with each shipment together with a certified copy of the weight of each delivery.

For all work involved in constructing the treated subgrade as specified, other than furnishing the stabilizing material, measurement will be on a square yard basis, to the nearest

square yard, of the finished surface of the treatment within the lines as shown on the Plans and/or as established by the Engineer.

No separate measurement will be made for water.

II.2.F.01.2 OVEREXCAVATION

When specified, quantities for overexcavation will be measured on a cubic yard basis. The measurement will be based on a cross-section of compacted material in place in the designated overexcavation areas and to the lines and grades as specified.

When specified, quantities for overexcavation will be measured on a ton basis of the aggregate backfill. Material receipts showing certified scale weights will be required from the Contractor.

II.2.F.01.3 STABILIZATION WITH FABRICS

The fabric shall be measured on a square yard basis in place, to the nearest square yard, and shall include only that area to the lines as specified and as directed by the Engineer. Overlap joints will not be considered in the computation of the area and shall be considered as incidental.

II.2.F.01.4 BITUMINOUS CURING SEAL

The asphalt emulsion used for the bituminous curing seal shall be measured in tons, to the nearest 0.01 ton, and shall include only that asphalt emulsion actually incorporated in the seal. Material receipts showing certified scale weights will be required from the Contractor.

II.2.F.02 PAYMENT

II.2.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to subgrade stabilization construction performed on the contract work under Section II.2, SUBGRADE STABILIZATION, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools materials and incidentals necessary for all of the contract work as specified for performance under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

II.2.F.02.2 PAY ITEMS

Pay Item Description	Unit of Measure
Chemical Stabilizing Material (Hydrated Lime, Granular Quicklime, Cement)	Tons
Treated Subgrade Construction	Square Yards
Overexcavation	Cubic yards or tons
Fabric Stabilization	Square Yards
Asphalt Emulsion in Seal	Tons

II.3 BASES

II.3.A.00 DESCRIPTION/SCOPE

This section covers the work necessary to furnish and place aggregate bases, either untreated or treated, on a prepared subgrade surface.

II.3.B.00 DEFINITIONS

II.3.C.00 MATERIALS

II.3.C.01 AGGREGATE

II.3.C.01.1 GENERAL

Aggregates for aggregate bases shall be crushed gravel or crushed rock, including sand.

II.3.C.01.2 FRACTURE OF GRAVEL

Base material produced from gravel shall have at least one mechanically fractured face based on the following percentage of particles retained on the 1/4-inch sieve for the designated size:

Minimum Percent
of Fractured Particles
(by weight) of Material

DESIGNATED SIZE	RETAINED ON 1/4-INCH SIEVE
1 1/2-inch - 0 and larger	50
Smaller than 1 1/2-inch - 0	70

The fractured particles shall be reasonably well distributed in proportion to the component fractions of base aggregate larger than the 1/4-inch sieve as set forth in the table entitled "Grading Requirements" in Section II.3.C.01.6, GRADING REQUIREMENTS.

II.3.C.01.3 DURABILITY

The source material from which aggregate base materials are obtained, produced or manufactured shall meet the following qualifying test requirements:

TEST	TEST METHOD	REQUIREMENTS
Degradation: Passing No. 20 Sieve	ODOT TM 208	30% Maximum
Sediment Height	ODOT TM 208	3-inch Maximum
Abrasion	AASHTO T96	35% Maximum

II.3.C.01.4 SAND EQUIVALENT

Base aggregates to be incorporated in the work shall have a sand equivalent of not less than 30 when tested in conformance with AASHTO T176.

II.3.C.01.5 LIQUID LIMIT AND PLASTICITY

Base aggregate shall meet the following requirements:

QUALITY	TEST METHOD	REQUIREMENTS
Liquid Limit	AASHTO T89	NP or 33 Max.*
Plasticity Index	AASHTO T90	NP or 6 Max.*

*When tested as specified and both the liquid limit and plasticity index are reportable with a numerical value, the pertinent quality requirements will be met when the numerical values of the test results conform to the following table:

LIQUID LIMIT AND PLASTICITY INDEX VALUES		
Percent of Material Passing No. 40 Sieve	Liquid Limit (Maximum) AASHTO T89	Plasticity Index (Maximum) AASHTO T90
0.0 to 5.0, inclusive	33	6
5.1 to 10.0, inclusive	30	5
10.1 to 15.0, inclusive	27	4
15.1 to 20.0, inclusive	24	3
20.1 to 25.0, inclusive	21	2
Over 25.0	21	0 or NP

II.3.C.01.6 GRADING REQUIREMENTS

Base aggregate shall be uniformly graded from course to fine and shall conform to one or another of the grading requirements set forth in the following table:

GRADING REQUIREMENTS					
Sieve Size Passing	Separated Sizes				
	2 ½- inch- 0	2-inch - 0	1-1/2- inch-0	1-inch-0	¾- inch-0
	Percentages (by weight)				
3-inch	100				
2 ½-inch	95-100	100			
2-inch		95-100	100		
1 ½-inch			95-100	100	
1 ¼-inch	55-75				
1-inch		55-75		90-100	100
¾-inch			55-75		90-100
½-inch				55-75	
3/8-inch					55-75
1/4-inch*	30-45	30-45	35-50	40-55	40-60

*Of the fraction passing the 1/4-inch sieve, 40% to 60% shall pass the No. 10 sieve.

Where a tolerance range is set forth in the above grading requirements, it shall be understood that the midpoint of the tolerance range is the target value and the product shall conform as closely as realistically possible to this target value. The purpose of the tolerance range is only to permit occasional minor variations from the target value that are, for practical reasons, unavoidable.

The determination of sizes and grading shall be in conformance with AASHTO T27.

II.3.C.02 WATER

Conform to Section II.2.C.04, WATER.

II.3.C.03 PORTLAND CEMENT

Conform to Section II.5.C.01, PORTLAND CEMENT.

II.3.C.04 BITUMINOUS MATERIAL

The asphalt for the curing seal shall be a rapid setting emulsified asphalt and the asphalt for the tack coat shall be a slow setting emulsified asphalt, each conforming to the applicable requirements of the AASHTO M140 or AASHTO M208 and as directed by the Engineer.

II.3.C.05 ASPHALT CEMENT

Asphalt materials incorporated in the asphalt treated base mix shall be of the type and grade specified and shall conform to the applicable requirements of AASHTO M226. As a minimum grade AR 4000 shall be used. The grade of the asphalt cement may be changed by the Engineer at his discretion but with due regard for availability and the Contractor's supply of asphalt cement on hand.

II.3.D.00 CONSTRUCTION/WORKMANSHIP

II.3.D.01 UNTREATED AGGREGATE BASE

II.3.D.01.1 SUBGRADE

Bases shall be placed on a subgrade which has been prepared in accordance with Section II.1.D.05, SUBGRADE.

II.3.D.01.2 MIXING

Mixing shall provide a homogeneous mixture of unsegregated and uniformly dispersed materials. Water shall be added during mixing in an amount sufficient to provide optimum moisture content plus or minus 2 percentage points.

The Contractor shall mix the base course materials by any one of the following methods:

Stationary Plant Method - The materials shall be mixed in a pug mill or rotary type mixer. After mixing, the mixture shall be transported to the job site at the proper moisture content and placed on the road by means of an approved aggregate spreader.

Travel Plant Method - After the material for each layer has been placed through an aggregate spreader or windrow sizing device, it shall be uniformly mixed by a traveling mixing plant.

Road Mix Method - After material for each layer has been placed, the materials shall be mixed by means of motor graders or other suitable equipment until the mixture is uniform throughout.

II.3.D.01.3 HAULING AND PLACING

II.3.D.01.3.a WEATHER LIMITATIONS

When, in the judgment of the Engineer, the weather is such that satisfactory results cannot be secured, the Contractor shall suspend operations until directed otherwise. No base materials shall be placed in the snow, or on a soft, muddy or frozen subgrade. The City shall not be liable for damages or claims of any kind or description by reason of operations suspended by the Engineer.

II.3.D.01.3.b EQUIPMENT

Equipment necessary for construction of an aggregate base will vary depending upon the method of mixing chose by the Contractor; however, equipment shall provide for efficient and continuous operations insofar as is practicable. Equipment used shall conform to the following requirements unless otherwise approved:

Hauling Equipment - Vehicles for hauling aggregate or mixtures of aggregate and water shall be capable of depositing the material within the receiving hopper of spreading equipment or windrow devices or windrows or reasonably uniform size in front or spreading equipment, with minimum of mix separation.

Spreading Equipment - Spreading equipment shall have an adjustable screed or strike-off assembly and it may have a receiving, mixing and distribution system. It may be a complete and integral unit, self-propelled and powered; a crawler-track or wheeled type tractor intimately combined with a receiving, mixing, spreading and screeding unit attached thereto; or a heavy-duty self-propelled grader, equipped with at least an 8-foot blade. Equipment used shall be capable of spreading and striking off material to the designated line, grade and traverse slope with surface texture of uniform appearance without excessive segregation or fracture of material.

II.3.D.01.3.c THICKNESS OF LIFTS

If the required compacted depth of the base materials exceeds 6-inch, it shall be constructed in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any 1 layer shall not exceed 6-inch. Each layer shall be placed in spreads as wide as practicable and to the full width of the course before a succeeding layer is placed.

II.3.D.01.4 COMPACTION AND DENSITY REQUIREMENTS

At the time the compacting begins, the materials shall be at the moisture content specified or directed, within a tolerance of plus or minus 2%. The compaction of each layer shall begin as soon as practicable after the material is spread and shall continue until a density of not less than 95% of the maximum relative density has been achieved as determined by AASHTO T99.

When requested by the Engineer, the Contractor shall supply samples of their aggregates for used in determining maximum densities and optimum moistures according to AASHTO T99.

The Contractor shall maintain the surface of each layer during compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly keyed. When needed for proper compaction, the Contractor shall apply water to the materials, as directed by the Engineer.

II.3.D.01.5 SURFACE FINISH

The aggregate base surface shall parallel the cross section and grade of the finished surface within 0.05-foot, and when tested with a 10-foot straight edge shall not vary from the testing edge by more than 0.04-foot at any point.

II.3.D.01.6 CARE OF THE WORK

During the construction of the base, the Contractor shall exercise care to protect the work from damage. Following construction of each strip and each layer of the base and following construction of the entire course of the base, the Contractor shall perform such work as the Engineer may determine to be necessary to prevent raveling and rutting, to repair weak spots, to prevent segregation of materials, and to maintain the layer or course of the base to the specified density and surface finish; all until the strip, layer or course is covered by a following layer or course of material or until all work under the contract is completed.

II.3.E.00 TESTING

II.3.E.01 UNTREATED AGGREGATE BASE

II.3.E.01.1 MATERIALS

Sampling and testing of materials for determination of compliance with the specified requirements may be at any point as the Engineer may determine. When specified or directed by the Engineer, the Contractor shall furnish certified laboratory tests that the Engineer may require showing results of the specified tests at no expense to the City. When specified, the Engineer may do the sampling and/or testing of the materials as required. If evidence of noncompliance with the requirements exists, additional tests may be required to insure that the materials meet the requirements as specified at no expense to the City.

II.3.E.01.2 COMPACTION AND DENSITY

Unless otherwise directed by the Engineer, the density and moisture content requirements as determined by AASHTO T99 shall be tested by the Engineer using a nuclear density - moisture gauge prior to final untreated aggregate base approval.

II.3.E.01.3 GRADE AND CROSS-SECTION

The specified grade and cross-section shall be checked by the Engineer using hand levels, tapes, string lines, straight edges, and/or other appropriate methods prior to final aggregate base approval.

II.3.F.00 MEASUREMENT AND PAYMENT

II.3.F.01 MEASUREMENT

II.3.F.01.1 UNTREATED AGGREGATE BASE

When specified, quantities for aggregate base will be measured on a square yard basis in place. The measurement will be based upon the top surface length and width, up to the specified length and width, of the aggregate base measured to the nearest 0.1-foot and the area measured to the nearest square yard.

When specified, quantities for aggregate base will be measured on a ton basis, to the nearest 0.1 ton, up to the specified amount of aggregate. Material receipts showing certified scale weights will be required from the Contractor.

II.3.E.01.3 BITUMINOUS CURING SEAL

The asphalt emulsion used for the bituminous curing seal shall be measured in tons, to the nearest 0.01 ton, and shall include only that asphalt emulsion actually incorporated in the seal. Material receipts showing certified scale weights will be required from the Contractor.

II.3.F.02 PAYMENT

II.3.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to base construction performed on the contract work under Section II.3, BASES, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidentals necessary for all of the contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

II.3.F.02.2 PAY ITEMS

PAY ITEMS	UNIT OF MEASURE
Aggregate Base	Square Yards or Tons
Asphalt in Seal	Tons

II.4 ASPHALTIC CONCRETE (AC) PAVEMENT

II.4.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of one or more courses of hot mixed AC pavement, plant mixed into a uniformly coated mass, hot laid on a prepared subgrade

or base, compacted to specified density, and finished to a specified smoothness to the lines, grades, thickness, and cross sections shown or established.

II.4.B.00 DEFINITIONS

II.4.B.01 ODOT STANDARD SPECIFICATIONS

Oregon Department of Transportation (ODOT) *Standard Specifications for Highway Construction*, including supplements. Copies of this publication, as well as other ODOT specifications referenced herein are available from ODOT's Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the project is advertised. If requirements contained in the ODOT *Standard Specifications* are modified by or are in conflict with supplemental information in these documents, the requirements of these *City of Corvallis Standard Specifications*, herein referred to as the Standards, shall prevail.

II.4.B.02 HOT MIX ASPHALTIC CONCRETE (HMAC)

HMAC is defined as a uniformly coated mixture of asphalt cement; well-graded, high quality aggregate; mineral filler and additives as required; heated and plant mixed into a uniform coated mass.

II.4.B.02.1 LEVEL 1 HMAC

HMAC for use in applications with very low traffic and limited exposure to trucks.

II.4.B.02.2 LEVEL 2 HMAC

HMAC for use in applications with low traffic volumes and low volume truck traffic.

II.4.B.02.3 LEVEL 3 HMAC

HMAC for use in applications exposed to moderate truck traffic.

II.4.B.02.4 LEVEL 4 HMAC

HMAC for use in applications exposed to very heavy traffic volumes or heavy truck traffic.

II.4.B.02.5 JOB MIX FORMULA (JMF)

The Job Mix Formula is the stamped and approved mix design for the project, as per ODOT *Standard Specifications* Section 00745, Hot Mix Asphalt Concrete (HMAC) and as approved by the Engineer.

II.4.B.03 RECLAIMED ASPHALT PAVEMENT (RAP)

Reclaimed Asphalt Pavement (RAP) refers to processed recycled asphalt pavement materials used in the production of new asphalt concrete pavement.

II.4.C.00 MATERIALS

II.4.C.01 GENERAL

The HMAC shall be a well-graded, uniform, durable mix of the level as shown on the plans or approved by the Engineer. The components shall be within the broadband limits as defined by ODOT *Standard Specifications* Section 00745 Hot Mix Asphalt Concrete.

II.4.C.02 ASPHALT CEMENT

Asphalt cement shall conform to the requirements of ODOT's most current *Standard Specifications for Asphalt Materials*.

II.4.C.03 AGGREGATE

II.4.C.03.1 GENERAL

Aggregate shall be hard, sound, durable, and free of deleterious substances. Aggregate soundness, durability, minimum number of fractured faces, and maximum percentage of allowable harmful substances shall comply with ODOT *Standard Specifications* Section 00745 Hot Mix Asphalt Concrete.

II.4.C.03.2 COURSE & FINE AGGREGATES

Coarse and fine aggregates shall conform to ODOT *Standard Specifications* Section 00745 Hot Mix Asphalt Concrete.

II.4.C.03.3 RECLAIMED ASPHALTIC PAVEMENT (RAP) AGGREGATE

If RAP aggregates are used, they shall be no larger than the specified maximum allowable aggregate size before entering the cold feed. RAP aggregates shall be blended with new aggregate to provide a mixture conforming to the JMF within the tolerances specified.

II.4.C.04 MINERAL FILLER

Mineral filler shall conform to the requirements of AASHTO M17. Collector dust may be used as a mineral filler, in whole or in part, provided the dust or the resultant mineral filler mixture conforms to the AASHTO requirements.

II.4.C.05 ASPHALT CEMENT ADDITIVES

Asphalt cement additives may be used to prevent stripping or separation of asphalt coatings from aggregates, and admixtures used to aid in the mixing or use of asphalt mixes,

provided they meeting the requirements below and satisfying the Tensile Strength Ratio (TSR) specified in ODOT's *Standard Specifications* Section 00745 Hot Mix Asphalt Concrete (HMAC). Additives and admixtures shall be standard recognized products of known value for the intended purpose, and shall be approved by the Engineer on the basis of laboratory tests prior to their use in the work. Additives shall have no deleterious effect on the asphalt material and shall be completely miscible. Silicones may not be used as additives.

II.4.C.06 ASPHALT TACK COAT

An asphalt tack coat shall be constructed between all paved surfaces to ensure a bond between lifts as specified. The asphalt for the asphalt tack coat shall be a slow setting emulsified asphalt conforming to ODOT's *Standard Specifications* Section 00730, Asphalt Tack Coat, and *Standard Specifications for Asphalt Materials*, or as approved by the Engineer.

II.4.C.07 RUBBERIZED ASPHALT CEMENT CRACK SEALANT

Crack sealant material shall be a hot applied rubberized asphalt cement complying with ASTM D 1190 and as listed in the most current ODOT *Qualified Products Listing*.

II.4.C.08 RECLAIMED ASPHALT PAVEMENT (RAP)

Reclaimed HMAC pavement (RAP) material used in the production of new HMAC is optional. The RAP materials proposed for use in the recycled mix shall contain hard, sound, durable aggregates and asphalt cement. No more than 30% RAP material will be allowed in new HMAC pavement. RAP material will not be permitted in open graded HMAC or Level 4 dense graded HMAC wearing courses.

The amount of asphalt cement in the RAP shall be established in the mixture design phase according to ODOT TM 323 and AASHTO T 308 or other method if approved by the Engineer. Additional testing may be requested at any time by the Agency or the Contractor during the production of the RAP mixture to verify the amount of asphalt cement in the RAP. Conduct new tests by a laboratory mutually agreed upon by the Agency and the Contractor. The cost of additional testing will be paid for by the party requesting the testing.

II.4.C.09 COMPOSITION AND PROPORTION OF MIXTURES

The HMAC grade shall be specified in the Contract Documents and/or by the Engineer. Mix type and broadband limits as well as Job Mix Formula (JMF) requirements and tolerances shall conform to the requirements of ODOT *Standard Specifications* Section 00745 Hot Mix Asphalt Concrete (HMAC).

II.4.D.00 CONSTRUCTION/WORKMANSHIP

II.4.D.01 BASE

The HMAC pavement shall be placed on a base and/or subgrade as specified which has been prepared in accordance with Section II.3, BASES and/or Section II.1.D.05, SUBGRADE and Section II.2 SUBGRADE STABILIZATION of these Standards. All subgrade and base work shall be approved by the Engineer prior to the start of paving.

II.4.D.02 RECONDITIONING OLD ROADBED

When specified, this work shall consist of reconditioning and preparing previously constructed roadbed subgrades, existing rock bases and surfacing, and existing pavements not constructed by the Contractor under the pertinent contract, but on which an additional layer or course of material is to be placed under the Contract.

Existing aggregate subbases, bases and surfacing shall be bladed, scarified, leveled, and compacted in conformance to the lines, grades, and cross sections established by the Engineer in accordance with Section II.1 EARTHWORK and Section II.2 SUBGRADE STABILIZATION of these Standards.

Uneven, broken, or ragged edges of existing bituminous, Cement Concrete, or other surfaces over which HMA is to be placed shall be trimmed if necessary, and pre-leveled with asphalt concrete as specified.

The Contractor shall loosen and remove all vegetation from existing pavement and cracks. Immediately prior to paving, the Contractor shall wash and sweep the street as directed by the Engineer.

Cracks and holes between 1/4-inch and 3/4-inch shall be cleaned with compressed air and filled completely with rubberized asphalt cement crack sealant meeting the requirements of Section II.4.C.07 RUBBERIZED ASPHALT CEMENT CRACK SEALANT of these Standards, or as approved by the Engineer. Cracks and holes larger than 3/4-inch shall be repaired with an approved slurry seal or HMA mixture.

Crack cleaning equipment, crack sealant material, and the crack sealing applicator shall be approved by the Engineer prior to use. The approved crack sealant material shall be applied in conformance with the manufacturer's instructions and recommendations. Application shall be performed using an approved pressure feed wand system. Pour pot application will not be allowed. A copy of the manufacturer's specifications including application procedures shall be furnished to the Engineer upon request and prior to application. The Engineer may order a test run of any application method or material prior to filling of the cracks.

II.4.D.02.1 PRE-LEVELING EXISTING SURFACES

All depressed areas in existing pavement shall be leveled with an approved HMA mixture and compacted with a pneumatic tired roller. This leveling work shall be a separate operation and performed as specified or directed, prior to paving. Leveling material shall be spread by means of a paving machine except in small or irregular areas where the Engineer may permit the use of other equipment. When leveling irregular surfaces and raising low areas, actual compacted thickness of any one lift shall not exceed 2-inch. At the direction of the Engineer, leveled areas shall be tacked with an emulsified asphaltic tack coat as specified in Section II.4.D.02.2 ASPHALT TACK COAT of these Standards prior to placement of subsequent material.

II.4.D.02.2 ASPHALT TACK COAT

All paved surfaces on and against the HMA, including all cold longitudinal and transverse joints and preleveled areas as directed, shall be treated with an emulsified asphalt

tack coat meeting the requirements of ODOT *Standard Specifications* Section 00730 and ODOT's *Standard Specifications for Asphalt Materials*. Pumping between the bulk storage tank, hauling transportation, field storage tanks, and distributor shall be kept to a minimum to maintain proper viscosity. Final acceptance of emulsified asphalt will be at the point of application.

Surfaces where tack coat is to be applied shall be clean and dry, and free of all, material, loose or otherwise, that will reduce adhesion of the tack. The asphalt tack coat shall be applied uniformly with a distributor meeting the requirements of Section II.4.D.05.1 ASPHALT TACK COAT DISTRIBUTOR of these Standards at a rate between 0.05 and 0.20 gallons per square yard and with the emulsified asphalt temperature between 140°F and 185°F, or as recommended by the Manufacturer. HMAC pavement shall be placed on the tack coat after the asphalt separates from the water (breaks), but before it loses its tackiness. The Contractor shall be responsible for re-application of missed or lightly coated surfaces, and for removing excess tack coat.

II.4.D.03 MIXING AND DISCHARGE TEMPERATURES

All HMAC mixing and placement temperature ranges shall be established based on the JMF, and shall conform to ODOT *Standard Specifications* Section 00745. The allowable production temperatures may be adjusted based on the HMAC supplier's recommendation if approved by the Engineer. The mixture temperature shall be measured at the discharge of the mixer, and the placement temperature shall be measured behind the paver. The maximum mixture temperature of the HMAC and the minimum placement temperature shall be as follows:

Grading	AC TEMPERATURE, °F	
	Maximum at Mixer	Minimum Behind Paver
Dense	350	240
Open	350	205

Within the above limits, the Contractor (with approval of the Engineer) or the Engineer may adjust this temperature in 10°F increments from the JMF as follows: (a) Up if the aggregate coating, moisture content, workability, or compaction requirements are not attained; or (b) down if the aggregate coating, moisture content, workability, and compaction requirements are attained.

II.4.D.04 WEATHER LIMITATIONS

The HMAC shall be placed normally on dry prepared surfaces and when the air temperature is 40°F and warmer. Placing of HMAC at lower temperatures, or during rain or other adverse weather conditions will not be permitted unless approved by the Engineer. Mix in transit at the time these adverse conditions occur may be laid if it has been covered during transit, meets specified temperature requirements, is placed on a foundation free from pools or flow of water, and all other requirements are met.

II.4.D.05 EQUIPMENT

II.4.D.05.1 ASPHALTIC TACK COAT DISTRIBUTOR

The asphalt distributor for application of tack coats shall be designed, equipped, maintained, and operated so the emulsified asphalt material may be applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16-foot, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Distributor equipment shall be equipped with a tachometer, pressure gages, accurate volume measuring devices, a thermometer for measuring temperature of tank contents, and a positive power unit for the asphalt pump. Distributor equipment shall also have full circulation spray bars adjustable both laterally and vertically. Bar height shall be set for triple lap coverage.

II.4.D.05.2 HAULING EQUIPMENT

Hauling equipment shall be in good operating condition with tight, clean, smooth beds. Beds shall be coated with a minimum amount of paraffin oil, lime solution, soapy water or other approved material to prevent the HMAC from sticking to the beds. Diesel oil shall not be used, unless approved by the Engineer. Excess coating material shall be drained from the hauling equipment before each loading. Vehicles which cause excessive segregation, leak badly, or delay normal operations, as determined by the Engineer, shall not be used. Unless otherwise approved by the Engineer, vehicles shall be equipped with covers to protect against moisture intrusion and heat loss, and shall have a 3/8-inch diameter hole near the middle of the left side wall of the bed to allow access for a thermometer.

II.4.D.05.3 HMAC PAVERS

HMAC Pavers shall be self-contained, self-propelled units equipped with augers and a screed or strike-off assembly, heated if necessary, and capable of spreading and finishing layers of HMAC material to the widths, thicknesses, lines, grades, and cross sections required. The screed or strike-off assembly shall produce a finished surface of the required smoothness and texture without tearing, shoving, or gouging the mixture.

HMAC pavers shall be equipped with a receiving and distribution system of sufficient capacity for a uniform spreading operation and capable of placing the mixture uniformly in front of the screed without segregating the material. Extensions added to the paver when used on travel lanes shall have the same auguring and screeding equipment as the rest of the paver. Pavers used for shoulder work and similar construction shall be capable of spreading and finishing to the widths shown on the Plans.

The paver shall be designed so minor irregularities in the surface of the base will not be reflected in the surface of the layer being placed. The weight of the paver shall be supported on tracks or wheels none of which shall contact the mixture being placed. The contact area of the screed or strike-off assembly shall be uniform over the entire width of the mixture being placed.

HMAC pavers shall be equipped with a paver control system which controls the HMAC placement to specified slope and grade, maintains the paver screed in proper position, and provides the specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references.

II.4.D.05.4 HMAC COMPACTORS

HMAC compactors shall be steel wheel, pneumatic tire, vibratory, or a combination of these, as the Contractor may elect. The use of equipment which crushes the aggregate will not be permitted. HMAC compactors shall be operated at speeds slow enough to avoid displacement of the HMAC. HMAC compactors shall be in good condition, capable of reversing without backlash, and shall meet the following requirements:

II.4.D.05.4.a STEEL-WHEELED ROLLERS

Steel-wheeled rollers shall have a gross static weight of at least 8 tons. If steel-wheeled rollers are used for finish rolling, they shall have a gross static weight of at least 6 tons.

II.4.D.05.4.b VIBRATORY ROLLERS

Vibratory rollers shall be specifically designed to compact HMAC and shall be equipped with amplitude and frequency controls, shall be capable of maintaining a minimum of 2000 vibrations per minute, and shall have a gross static weight of at least 8 tons. Vibratory rollers shall not be operated in vibratory mode for lifts thinner than two times the maximum aggregate size for the type of HMAC being compacted. If vibratory rollers are used for finish rolling, they shall not be operated in vibratory mode, and they shall have a gross static weight of at least 6 tons.

II.4.D.05.4.c PNEUMATIC-TIRED ROLLERS

Pneumatic-Tired Rollers. Pneumatic-tired rollers shall: be tandem, or multiple axle, multiple wheel type; have smooth-tread, pneumatic tires of equal size; have tires staggered on the axles, spaced and overlapped to provide uniform compacting pressure for the full compacting width; have a minimum total load of 2,800 pounds per tire with tire inflation pressures of 45 to 95 psi; and be fully skirted to reduce tire heat loss and mixture pick up.

II.4.D.06 CONTROL OF LINE AND GRADE

The Contractor shall furnish, place, and maintain supports, wires, devices, and materials as necessary to provide continuous line and grade reference control to the paver control system on either or both sides of the paving machine.

With the approval of the Engineer, the line and grade reference control may be a floating beam device or multi-footed ski of a length and sensitivity that will allow control of the paver to the grade specified. After paving the first lane, a joint matcher or manual control of line and grade will be permitted with approval of the Engineer.

II.4.D.07 HAULING AND PLACING

HMAC shall be covered if rain or cold air temperatures are encountered any time between loading and placement. HMAC will be rejected before placing if it is below specified placement temperature limit, or if the mixture is slumping, separating, solidifying, crusting, or absorbing moisture. HMAC in transit at the time adverse conditions occur may be placed, as approved by the Engineer, if it has been covered during transit, meets specified temperature requirements, is placed on a foundation free from pools or flow of water, and all other requirements are met.

Loads of HMAC shall be delivered to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the mixture delivery rate matches the paving machine operation.

No loads of HMAC shall be transported from the mixing plant to the point of use so late in the day as to prevent the spreading and compacting of the mixture during daylight, unless otherwise approved by the Engineer. If placing of material during other than daylight hours is permitted by the Engineer, adequate lighting shall be provided.

If HMAC is windrowed, the pick-up equipment shall pick up substantially all of the HMAC deposited on the roadway, shall be self supporting, and shall not exert any vertical load on the paving machine, nor cause vibrations or other motions which would have a harmful effect on the riding quality of the completed pavement.

Alternative equipment and means of placing may be allowed by the Engineer if the use of a paver is impractical. Disposal of rejected loads shall be at the Contractor's expense.

The pavement surface shall be dry prior to the preparation work and paving. All temporary traffic buttons and epoxy shall be removed prior to paving.

II.4.D.08 THICKNESS AND NUMBER OF LAYERS

HMAC shall be placed in the number of lifts and courses, and to the compacted thickness for each lift and course as specified on the Plans or as directed by the Engineer. Each course shall be placed in one lift, unless otherwise specified. If the compacted thickness is not specified, the maximum compacted thickness for any course shall be 4-inch. The minimum lift thickness shall be twice the maximum aggregate size in the mix.

All HMAC used for trench patching shall match the existing asphalt section, but shall be no less than 4-inch of HMAC pavement placed in 2, 2-inch lifts of roller compacted mix as specified in the Plans or as directed by the Engineer.

II.4.D.09 LONGITUDINAL AND TRANSVERSE JOINTS

Placing of a course or strip of HMAC shall be as nearly continuous as practicable. Enough trucks shall be provided to allow for the continuous operation of the paver without delays. Stopping the paver between trucks shall be avoided.

The Contractor shall place the HMAC in panel widths which hold the number of longitudinal joints to a minimum. Longitudinal joints in one panel shall be offset by at least 6-inch from the longitudinal joints in the panel immediately below. Base course longitudinal joints shall be placed within 12-inch of the edge of a lane or within 12-inch of the center of a lane, except in irregular areas, unless otherwise directed. Wearing course longitudinal joints shall not occur within the width of a traffic lane. On median lanes and on shoulder areas the longitudinal joints shall occur only at lane lines or at points of change in the transverse slopes, as shown or as directed.

Special care shall be taken at longitudinal joints to provide positive bond and to provide density and finish to new mixture equal in all respects to the mixture against which it is placed. When directed, an emulsified asphalt tack coat shall be applied to each layer of asphalt concrete or at longitudinal joints prior to placing succeeding lifts.

Longitudinal joints where abrupt or sloped edge drop-offs of 1-inch or more in height occur and which are subject to traffic shall be marked with warning signs and markings according to ODOT *Standard Specifications* Section 00225. In addition, the Contractor shall construct and maintain a temporary wedge of HMAC at a slope of 1V:10H or flatter along the exposed longitudinal joint.

Transverse joints shall be carefully constructed with a smooth vertical face the full depth of the course being laid, and shall be thoroughly compacted to provide a smooth riding surface.

If a transverse joint is to be subjected to traffic, the pavement depth, line, and grade shall be maintained at least 4-foot beyond the selected transverse joint location, and a sloped end panel shall be constructed at the appropriate taper rate specified below. For transverse joints that will be under traffic for less than 24 hours, sloped end panels shall be constructed using a 1V:50H taper rate. For transverse joints that will be under traffic for 24 hours or longer, sloped end panels shall be constructed using a 1V:60H taper rate.

When paving operations are not expected to continue from the transverse joint for 24 hours or more, the Contractor shall place a bond-breaker of paper, dust, or other suitable material below the transverse joint between the joint location and the end panel.

Prior to resuming paving operations at all longitudinal and transverse joints, the Contractor shall saw cut a smooth, vertical face to the full depth of the course being laid at the transverse joint location, remove temporary panels and bond-breakers, clean the surface of all debris, and apply an emulsified asphalt tack coat to the vertical edge and the surface to be paved. Construction, maintenance, and disposal of temporary panels shall be considered incidental, unless otherwise directed by the Engineer.

When new HMAC adjoins existing pavement, the existing pavement shall be saw cut to a neat straight line as specified. The existing saw cut shall be covered with an emulsified asphalt tack coat prior to jointing with the new asphalt concrete. When the air temperature is 40°F or below, the Engineer may require that the joint be heated prior to the application of the tack coat.

Both sides of transverse and longitudinal joints shall be compacted to the specified density. When tested with a straightedge placed across the joint, the joint surface shall conform to the specified surface tolerances. All completed transverse and longitudinal joints shall be uniformly

covered with an emulsified asphalt tack coat and sanded to provide a continuous texture across the joint.

Segregation of materials, nonuniform texture, fouled surfaces preventing full bond between successive spreads of mixture and other defects in material and workmanship, determined by the Engineer as detrimental, shall be corrected by the Contractor at the Contractor's expense.

Vertical faces of curbs, gutters, catch basins, manholes, or other appurtenances against which the HMAC is to be placed, shall first be uniformly covered with an emulsified asphalt tack coat.

Access to all driveways during HMAC construction shall be maintained by placing a temporary active driveway ramp.

II.4.D.10 COMPACTION

Immediately after the HMAC has been spread, struck off, and all surface irregularities and other defects remedied, it shall be thoroughly and uniformly compacted by rolling until the mixture is compacted to the density as specified in Section II.4.E.02 COMPACTION AND DENSITY TESTING of these Standards.

Breakdown and intermediate compaction of the HMAC shall begin when the mixture is in proper condition and the rolling does not cause undue displacement, cracking, or shoving of the HMAC, and shall be completed before the HMAC temperature drops below 180°F, unless otherwise directed by the Engineer. Steel-wheeled rollers shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture and to not cause spotting or defacement of the surface of the mixture. When rolling activities cause tearing, displacement, cracking, or shoving of the HMAC, the Contractor shall be required to make necessary changes in compaction temperature, type of compaction equipment, and rolling procedures.

Rollers used to compact the HMAC shall conform to Section II.4.D.05.4 HMAC COMPACTORS of these Standards. The Contractor will supply an inventory of compaction equipment to be used on the project with the Job Mix Formula submittal. The Contractor shall provide sufficient rollers of the types appropriate to compact the mixture while it is still within the specified temperature range and in a workable condition. On Level 1 and Level 2 HMAC, and on pavement sections less than 500-foot, a vibratory roller may be used in place of a pneumatic roller, as approved by the Engineer. The Contractor shall have at least one available pneumatic tired roller on the project and in good operating condition for Level 3 and Level 4 HMAC.

Equipment which rushes the aggregate or displaces the line and grade of the HMAC shall not be used. Rollers shall not make sharp turns on the course being compacted, and they shall not be parked on the hot HMAC. Any displacement occurring as a result of reversing the direction of the roller, or from other causes, shall be corrected immediately by the use of rakes and the addition of fresh mixture when required. Care shall be exercised not to displace the line and grade of the edges. Steel roller wheels shall be moistened with a minimum amount of water, or other approved material, necessary to prevent HMAC from sticking to them and spotting and defacing the HMAC.

Rollers shall be operated at a slow, uniform speed recommended by the manufacturer and at speeds slow enough to avoid displacement of the mixture. Drive rolls or wheels shall be nearest the paver unless otherwise approved. Vibratory rollers shall be operated at maximum speed of 3 mph and a minimum frequency of 2,000 vpm. Maximum speeds for steel-wheeled rollers shall be 4 mph, and 5 mph for pneumatic-tired rollers.

Unless otherwise specified, rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each strip overlapping one half of the roller width, gradually progressing to the center. Alternate trips of a roller shall terminate in stops at least 5-foot distance longitudinal from adjacent preceding stops. On superelevated curves, the rolling shall begin at the low side and progress to the high side, each pass overlapping one-half the roller width. When paving is in echelon or when abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Perform finish rolling with tandem steel wheel rollers or vibratory rollers.

Along curbs and walls, sidewalks, irregular areas, and other areas not practicably accessible to specified rollers, the mixture shall be compacted with small rollers, mechanical tampers, hot hand tampers, or smoothing irons. On depressed areas, a trench roller or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Any mixture that becomes loose or broken, mixed with dirt, or is in any way defective shall be subject to removal and to replacement with fresh hot mixture, which shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of HMAC shall be subject to removal and to replacement. Removal and replacement shall be at the expense of the Contractor unless the Engineer determines that the defects, excesses, or deficiencies are not caused by the Contractor, or the fault of the Contractor's operations.

Any damage to existing utilities, adjacent property, or to the pavement, base, subgrade, or any other portions of the new construction caused by the rollers shall be the responsibility of the Contractor.

II.4.D.11 SURFACE FINISH

The finished surface of each course or layer of mixture shall be of uniform texture, smooth, free of all defects, and shall closely parallel that specified for the grade and cross section of the top surface of the finished pavement. The surface of each layer will be tested for trueness to specified grade and cross section at selected locations with a 12-foot straight edge, as per Section II.4.E.00 TESTING of these Standards.

II.4.D.12 CARE OF THE WORK

In addition to other required provisions for traffic, the following shall apply to HMAC base or pavement construction: no traffic or equipment shall come in contact with the compacted mixture until it has cooled and set sufficiently to prevent marking; edges shall be protected from being broken down; and edge drop-offs one or more inches in height for which temporary transitions have not been constructed shall be marked with warning devices visible by day and night to the traveling public, and placed at spacings sufficiently close to delineate the alignment and location of the hazard. Any damage to the pavement during construction or until all work under the contract is completed shall be repaired by the Contractor at no expense to the City.

II.4.E.00 TESTING

II.4.E.01 MATERIALS AND MIXTURE

At least 1 week prior to any paving by the Contractor, or as specified in the Plans, the Contractor shall submit a Job Mix Formula (JMF) to the Engineer for approval. The JMF shall show the proportions of each of the constituents to be used in the HMAC.

Plant mixed mixtures will be subject to acceptance according to the specified JMF at the place of delivery. A minimum of 2 samples shall be taken for each 500 tons, or proportion thereof of HMAC placed per project, unless otherwise directed by the Engineer. The test results shall include, as a minimum, the percent asphalt of the mixture and the gradation of the aggregate present in the mixture.

Results of these tests shall be sent directly to the City as well as to the Contractor, by the laboratory. If evidence of noncompliance with the requirements exists, additional tests may be required to assure that the materials meet the requirements as specified. These additional tests shall be at the expense of the Contractor.

II.4.E.02 COMPACTION AND DENSITY TESTING

For dense graded HMAC, the mixture shall be compacted to at least 92% of the theoretical maximum density (Rice Density) as determined by ODOT TM 306.

For dense graded HMAC mixes with a thickness of less than 1 1/2-inch thick, the mix shall be compacted by at least 4 coverages of the breakdown roller, 2 coverages of the intermediate roller and such additional coverages as the Engineer may elect.

Compaction of open-graded mixes to a specified density will not be required.

Breakdown and intermediate rolling shall continue until the entire surface has been compacted with at least 4 coverages by a steel-wheeled roller. Additional coverages shall be performed, as directed and as necessary, to obtain thorough compaction and finish rolling of the HMAC.

Compaction to a specific density on temporary surfacing, guardrail flares, mailbox turnouts, road approaches, and areas of restricted width (less than 6-foot wide) or limited lengths (less than 50-foot), regardless of thickness, will not be required. Breakdown and intermediate rolling shall be continued until the entire surface has been compacted with at least 4 coverages by the roller(s). Additional coverages shall be performed, as directed and as necessary, to obtain thorough compaction and finish rolling of the HMAC.

Final acceptance of the HMAC for payment shall be determined by random acceptance testing of the compacted road surface using a calibrated nuclear density gauge or laboratory analysis of pavement core samples. Density tests will be taken at 50-foot to 100-foot intervals or as directed by the Engineer. If it is determined that any segment of asphalt is compacted to less than 92% of the theoretical maximum density, density tests will be taken at five randomly selected locations for each 100 lineal feet of suspect asphalt. The average of the five density tests will constitute the density of the HMAC section. Each density test taken using a nuclear density gauge shall consist of two readings, the second at right angles to the first, averaged to obtain the test density for that location.

The Engineer shall have the right to test any areas that appear defective in compaction. If the areas are found deficient, the Engineer may require the Contractor to bring the areas into conformance with the specifications.

Where in-place HMAC fails to meet the compaction standard of 92% of the theoretical maximum density, the Engineer may accept the pavement and shall make payment to the Contractor based on the payment schedule shown in Section II.4.F.02.2.a COMPACTION of these Standards.

Acceptance or payment will not be made for mixture compacted to less than 88% of theoretical maximum density. The Engineer may decide to allow the deficient pavement to remain in place. In that case, the Engineer and the Contractor will agree in writing that the pavement will remain in place. Additional remedial work may be required to in-place mixture compacted to less than 88%, as directed by the Engineer.

In addition to the specified unit price deduction shown in Section II.4.F.02.2.a COMPACTION, of these Standards, if the in-place compaction of more than 25% of the top lift mixture is 90% of theoretical maximum density or less, and at the Engineer's discretion, the Contractor shall fog seal the top lift of paving as directed. The fog seal shall be done at the Contractor's expense.

II.4.E.03 IN-PLACE SAMPLES AND THICKNESS

The Engineer shall be permitted to cut samples or to take cores or to require the Contractor to cut samples or take cores from the full depth of the compacted mixture or from the separate layers and courses thereof for testing purposes, and at such locations and at such frequencies as the Engineer determines as required for proper representation, all at the expense of the Contractor. Where samples have been taken and the samples show deficiencies according to these specifications, the Contractor shall repair the cuts or cores with like material and shall make repairs to the pavement as directed by the Engineer, all at no expense to the City. If the samples show no deficiencies, the cost of such sample taking and repairs shall be borne by the City.

Samples may be tested for specified thickness at random locations and frequencies as the Engineer determines as required for proper representation. The pavement shall be divided into 50 square yard lots by the Engineer for the purpose of identifying areas which may be deficient in thickness. For each entire lot of pavement, the contract unit price applicable to the pavement may be adjusted as set forth in Section II.4.F.02.1, if at any location in the lot the thickness of the pavement is found to be deficient by more than 0.25-inch.

In the case where a deficiency of more than 1-inch is found and the Engineer considers the deficiency serious enough to seriously impair the traffic service expected from the pavement, the area of such deficiency, together with areas as hereinafter set forth, shall be removed by the Contractor at his own expense and the removed pavement shall be replaced with pavement of the specified design, quality and thickness. If the replacement pavement is found acceptable, that area of it which replaces the actual area of deficiency will be included in the area measured for payment under the contract. In the case the Engineer considers there is little probability of early failure of the pavement found deficient by more than 1-inch, he may permit the Contractor to elect whether to leave the deficient pavement in place without payment as set forth in Section II.4.F.02.1, or to remove it and replace it with acceptable pavement as herein specified.

II.4.E.04 GRADE, CROSS SECTION, AND PAVEMENT SMOOTHNESS

The specified grade and cross section shall be checked by the engineer using hand levels, tapes, string lines, straight edges, and/or other appropriate methods prior to final AC pavement approval. The completed surface of all courses of the mixture shall closely parallel that specified for the top surface of the finished pavement, and shall be smooth and uniform in texture. The top surface of the HMAC shall not vary by more than 0.02-foot of the specified line, grade, and cross section when tested with a 12-foot straightedge furnished and operated by the Contractor, as directed by the Engineer. Joints between the pavement and the top surface of utility structures, such as manhole covers and valve boxes, located in the travel way shall also meet the pavement surface tolerances.

When tests show the pavement surface is not within the above tolerances, the Contractor shall take immediate action to correct equipment or procedures in the paving operations to eliminate the problem. Any surface irregularities exceeding the above tolerances shall be corrected by the Contractor using the following method(s), as approved by the Engineer: (a) remove and replace the surface course; (b) place an overlay of a thickness approved by the Engineer; (c) grind the pavement surface (1/2-inch for base lifts, 1/4-inch for wearing course) using an abrasive grinder equipped with a multiple diamond blade cutting head; or (d) other remedial actions as directed by the Engineer. If the corrective work does not meet the specified tolerances, the Contractor shall perform additional corrective work, as directed by the Engineer.

All corrective work, including furnishing of materials, shall be performed within 10 working days following notification from the Engineer. All corrective work shall be at the expense of the Contractor, and no adjustment in contract time will be given.

II.4.F.00 MEASUREMENT AND PAYMENT

II.4.F.01 MEASUREMENT

When specified, quantities for HMAC pavement will be measured on a square yard basis. The measurement will be based on the actual field top surface length and width, up to the specified length and width, as specified of the AC pavement measured to the nearest 0.1-foot and the area computed to the nearest square yard.

When specified, quantities for HMAC pavement will be measured on a ton basis, to the nearest 0.1 ton, for the actual tonnage of concrete delivered and placed up to 5% over the tonnage calculated from actual field area measurements and the specified thickness and density. Material receipts showing certified scale weights will be required from the Contractor.

II.4.F.02 PAYMENT

II.4.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to AC pavement construction performed on the contract work under Section II.4, ASPHALTIC CONCRETE PAVEMENT of these Standards, by reason of Special Provisions, shall be understood to comprise full and complete compensation

for all labor, equipment, tools, materials, and incidentals necessary for all of the contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this section will be considered as incidental work for which no separate payment will be made.

II.4.F.02.2 PAYMENT DEDUCTIONS AND REJECTION OF HMAC

II.4.F.02.2.a COMPACTION

Asphalt concrete pavement which does not comply with the compaction requirements shall be removed and replaced, or, at the discretion of the Engineer, be subject to a price reduction determined from the following table.

PRICE REDUCTION SCHEDULE	
% Maximum Theoretical Density (Rice Method)	% Pay*
92.0 and above	100
91.5 to 91.9	95
91.0 to 91.4	90
90.5 to 90.9	85
90.0 to 90.4	80
89.5 to 89.9	70
89.0 to 89.4	60
88.1 to 89.0	0 to 50**
88.0 and below	0

* Applies to price for in-place asphalt concrete, including asphalt cement where measured and paid for separately.

** As determined by the Engineer

II.4.F.02.2.b PAYMENT THICKNESS

Partial payment of deficiencies in thickness may be made according to II.4.E.03, IN-PLACE SAMPLES AND THICKNESS, and the following reduced payment schedule:

Deficiency in Thickness (inches)	Proportional Part of Contract Unit Price Allowed
0.00 to 0.25	100%
0.25 to 0.50	80%
0.51 to 0.75	60%
0.76 to 1.00	50%

No payment will be made for any area of pavement found deficient in thickness by more than 1-inch, even though such payment is permitted by the Engineer to remain in place under the provisions of II.4.E.03, IN-PLACE SAMPLES AND THICKNESS.

II.5 PORTLAND CEMENT CONCRETE (PCC) PAVEMENT

II.5.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of a pavement composed of PCC constructed on a prepared subgrade or base.

II.5.B.00 DEFINITIONS

II.5.C.00 MATERIALS

II.5.C.01 PORTLAND CEMENT

Portland cement shall conform to the following types as specified:

Type I	For general use when special properties of other type cements are not required.
Type IA	Air entraining cement for the same uses as Type I, where air-entrainment is desired.
Type II	For use when moderate sulfate resistance or moderate heat of hydration is required.
Type IIA	Air entraining cement for the same uses as Type II, where air entrainment is desired.
Type III	For use when high early strength is desired.
Type IIIA	Air entraining cement for the same uses as Type III, where air entrainment is desired.

Portland cement shall conform to the requirements of AASHTO M85 for low alkali cement except as follows:

1. Cement shall have a total alkali content (sodium and potassium oxide calculated as $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) not exceeding 0.8%.
2. Types I, IA, III, and IIIA shall contain a maximum of 10% tricalcium aluminate.
3. For Types II and IIA tricalcium silicate and tricalcium aluminate shall have a maximum total percentage of 58.

When not otherwise specified, Types I or IA shall be used. When approved in writing Types III or IIIA may be used in lieu of Types I or IA in the identical quantity as specified for Types I or IA.

II.5.C.02 AGGREGATE

II.5.C.02.1 COARSE AGGREGATE

II.5.C.02.1.a GENERAL

Coarse aggregate shall consist of rock, gravel, or other approved inert material of similar characteristics or combinations thereof having hard, strong, durable pieces free from adherent coatings.

II.5.C.02.1.b DELETERIOUS SUBSTANCES

The amount of deleterious substances shall not exceed the following:

	Percentages (by weight)
Lightweight Pieces	0.25
Friable Particles	2.00
Material Passing No. 200 Sieve	1.00 - 1.50
Wood Waste	0.05

The material shall also be reasonably free from all other deleterious substances.

II.5.C.02.1.c SOUNDNESS

When coarse aggregates are subjected to 5 alternations of the sodium sulfate soundness test (AASHTO T104), the weighted percentages of loss shall not be more than 12%. This requirement may be waived if aggregate for use in structures or portions of structures is not exposed to weathering.

II.5.C.02.1.d DURABILITY

The material from which coarse aggregates are produced or manufactured shall meet the following test requirement:

Test	Requirements
Passing No. 20 Sieve (ODOT TM 208)	30% Maximum
Sediment Height (ODOT TM 208)	3-inch Maximum
Abrasion (AASHTO T96)	30% Maximum

II.5.C.02.1.e GRADING

Coarse aggregate shall conform in maximum size separation into designated sizes and grading of the separated designated sizes as follows:

Maximum Size of Aggregates	Separated Sizes
2-inch	(2-inch-1-inch), (1-inch-No. 4)
1-1/2-inch	(1-1/2-inch-3/4-inch), (3/4-inch No.4)
1-inch	(1-inch-No. 4)
3/4-inch	(3/4-inch-No. 4)

If the Contractor desires to furnish the aggregate in more than one designated size as specified, he shall obtain written approval from the Engineer prior to the incorporation of any of these materials into any part of the work.

Oversized and undersized materials shall not exceed 11% for any separated size. The grading of each of the specified separated sizes of coarse aggregate shall be in conformance with the following:

GRADING REQUIREMENTS COARSE AGGREGATE - PCC				
Sieve Size Passing	Separated Sizes			
	2-inch - 1-inch	1-1/2-inch - 3/4-inch	1-inch - No. 4	3/4-inch - No. 4
	Percentages (by weight)			
2-1/2-inch	100			
2-inch	90-100	100		
1-1/2-inch	35 - 70	90-100	100	
1-inch	0-15	30-65	90-100	100
3/4-inch		0-15	50-80	90-100
3/8-inch			15-40	20-50
No. 4			0-10	0-10

When a tolerance range is set forth in the above grading requirements, it shall be understood that the midpoint of the tolerance range is the target value and the product shall conform as closely as realistically possible to this target value. The purpose of the tolerance range is only to permit occasional minor variations from the target value that are, for practical reasons, unavoidable.

When the coarse aggregate is to be separated into 2 sets as set forth herein above, the grading of the material in each separated size shall be so controlled, within the applicable range of requirements given in the Grading Requirements for coarse aggregates above, that the quantity of each separated size measured into the batch shall be not less than 35% nor more than 65% of the total quantity of coarse aggregate measured into the batch.

II.5.C.02.2 FINE AGGREGATE

II.5.C.02.2.a GENERAL

Fine aggregate shall consist of natural sand or other materials with similar characteristics, or a combination thereof, having hard, strong, durable particles.

Stone screening, if used shall consist of particles resulting from the crushing of clean, tough, durable rock or gravel conforming to the durability requirements for coarse aggregates as described in Section II.5.C.02.1.d, DURABILITY. In all other respects screenings shall conform to the requirements specified herein for fine aggregate.

II.5.C.02.2.b DELETERIOUS SUBSTANCES

The amount of deleterious substances shall not exceed the following limits:

	Percentages (by weight)
Friable Particles	1.00
Lightweight Particles	1.00
Material Passing No. 200 Sieve	4.00

The material shall also be reasonably free from all other deleterious substances, such as shale, alkali, mica, coated grains, soft and flaky particles.

II.5.C.02.2.c SOUNDNESS

When fine aggregate is subjected to five alternatives of the sodium sulfate soundness test (AASHTO T104), the weighted percentages of loss shall not be more than 10% by weight.

II.5.C.02.2.d ORGANIC IMPURITIES

All fine aggregate shall meet the requirements of AASHTO M6 for organic impurities.

II.5.C.02.2.e GRADING

Fine aggregate shall be graded from coarse to fine within the following limits:

GRADING REQUIREMENTS FINE AGGREGATE PCC	
Sieve Size Passing	Percentages (by weight)
3/8-inch	100
No. 4	90-100
No. 8	65-90
No. 16	45-75
No. 30	25-55
No. 50	5-30
No. 100	0-8

II.5.C.02.2.f SAND EQUIVALENT

Fine aggregate shall have a sand equivalent not less than 68.

II.5.C.02.2.g MORTAR STRENGTH

Fine aggregate shall develop, in the mortar strength test taken at 7 days, a compressive strength of at least 95% of mortar using Ottawa Sand.

II.5.C.02.3 SAND FOR MORTAR

Sand for mortar shall conform to the requirements of AASHTO M45. Testing shall conform to the OSHA test as listed in Section II.5.E.01, MATERIALS AND MIXTURES.

II.5.C.03 WATER

Water used in all work must be reasonably clean and free of oil, salts, acid, alkali, sugar, vegetative matter, silts, and any other substances which would be deleterious to the quality of the material to which it is applied or with which it is mixed and shall conform to AASHTO T26. When City water is to be used, the Contractor shall obtain a meter from the City Utilities Department.

II.5.C.04 ADMIXTURES

II.5.C.04.1 AIR ENTRAINING ADMIXTURES

Air entraining admixtures shall conform to the requirement of AASHTO M154 (ASTM C260) using one or another of the several tests as directed by the Engineer. Chloride content of the admixture shall not exceed 0.5% by weight.

II.5.C.04.2 WATER REDUCING, RETARDING AND ACCELERATING ADMIXTURES

Water reducing, retarding and accelerating admixtures shall conform to the requirements of AASHTO M194 (ASTM C494), using one or another of the several tests as directed by the Engineer. Chloride content of the admixture shall not exceed 0.5% by weight.

II.5.C.05 CURING MATERIALS

Curing materials shall conform to the following requirements as specified:

Polyethylene Sheets for Curing Concrete	AASHTO M171
Waterproof Paper for Curing Concrete	AASHTO M171
Liquid Membrane - Forming Compounds for Curing Concrete	AASHTO M148
White Polyethylene (Film) for Curing Concrete	AASHTO M171
Burlap Cloth (Jute or Kenaf)	AASHTO M182
Other Approved Materials or Methods	

II.5.C.06 JOINT MATERIALS

II.5.C.06.1 PREFORMED EXPANSION JOINT FILLERS

Preformed expansion joint fillers for concrete shall conform to the requirements of AASHTO M153 or AASHTO M213 except that those furnished under AASHTO M213 shall be tested in conformance with ASTM D1751. Fillers conforming to AASHTO M213, except that the binder, if other than bituminous material, may also be used provided that they otherwise meet this specification and provided further that they have been demonstrated to be rot and vermin proof for a period of at least 5 years.

II.5.C.06.2 PREFORMED BLASTOMERIC JOINT SEALS

Preformed BLASTOMERIC joint seals shall conform to the requirements of AASHTO M220.

II.5.C.06.3 POURED FILLER

Poured filler for concrete joints shall conform to the requirements of AASHTO M173 (ASTM D 1190)

II.5.D.00 CONSTRUCTION/WORKMANSHIP

II.5.D.01 BASE

The PCC pavement shall be placed on a base and/or subgrade as specified which has been prepared in accordance with Section II.1.D.05, SUBGRADE, and/or Section II.3, BASES.

II.5.D.02 MIX DESIGN

Portland cement, fine aggregate, coarse aggregate in required separated sizes, water, air entraining agents and other admixtures as required, shall be used in such proportions to produce a concrete of suitable workability, plasticity and entrained air content and of such strength as specified and required.

The Contractor shall design the mix in accordance with the following requirements unless otherwise specified:

1. Entrained Air shall meet the following requirements:

Maximum Size of Coarse Aggregate (inch)	Air Content (Percent by Volume)
1-1/2	5 ± 1
3/4, 1	6 ± 1
3/8, 1/2	7-1/2 ± 1

2. Slump shall not exceed 3-inch for vibrated concrete or 4-inch for non-vibrated concrete, according to the requirements of AASHTO T119. The slump shall be uniform for each batch as much as reasonably possible.

3. The maximum size of coarse aggregate to be used in non-reinforced PCC pavement shall be 2-inch.

4. The PCC shall be so proportioned as to provide a 28 day minimum ultimate compressive strength of 4,000 psi according to the applicable provisions of AASHTO T22 and AASHTO T23.

5. Water reducing admixture, when specified, shall be in accordance with the manufacturer's recommendations.

6. The mix design shall be uniform for each batch of concrete.

II.5.D.03 MIXING

II.5.D.03.1 GENERAL

The concrete may be mixed at the site of the work, at a central plant or while in transit, as the Contractor may elect. The concrete shall be machine mixed.

II.5.D.03.2 MIXING AT SITE

Concrete shall be mixed in a batch mixer of an approved size and type which will insure a uniform distribution of the materials throughout the mass.

The mixer shall be equipped with adequate water storage and a device for accurately measuring and automatically controlling the amount of water used in each batch. Preferably, mechanical means shall be provided for recording the number of revolutions for each batch and automatically preventing the discharge of the mixer until the materials have been mixed the specified minimum time.

The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch shall be deposited simultaneously in the mixer. No mixer having a rated capacity of less than a 1-sack batch shall be used nor shall a mixer be charged in excess of its rated capacity.

All concrete shall be mixed for a period of not less than 1-1/2 minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at a design speed of not less than 14 nor more than 20 revolutions per minute.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon the cessation of mixing for a considerable period, the mixer shall be thoroughly cleaned.

The above specification contemplates the use of conventional revolving drum type mixers. Other types may be used with the written permission of the Engineer.

II.5.D.03.3 TRUCK MIXING

Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, watertight and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured in accordance with Section II.5.C.00, MATERIALS, and II.5.D.02, MIX DESIGN, and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a tank for carrying mixing water. Only the prescribed amount of water shall be placed in the tank unless the tank is equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch in which case a tank will not be required. Truck mixers may be required to be provided with means by which the mixing time can be readily verified by the Engineer.

The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacture and stamped in metal on the mixer. Truck mixing shall be continued for not less than 70 revolutions nor more than 100 revolutions of the drum at the rate of rotation designated by the manufacturer and stamped in metal on the mixer. Mixing shall commence after all ingredients, including water, are in the drum. Additional mixing, if any, shall be of the rate of rotation as designated by the manufacturer as agitating speed. Mixing shall begin within 30 minutes after the cement has been added to either the water or aggregate. When cement is charged into a mixer drum containing water or surface-wet aggregate and when the temperature is above 90° F, or when high-early strength Portland cement is used, this limit shall be reduced to 15 minutes.

The limitation on time between the introduction of the cement to the aggregates and the beginning of the mixing may be waived when, in the judgment of the Engineer, the aggregates are sufficiently free from moisture so that there will be no harmful effects on the cement.

II.5.D.03.4 PARTIAL MIXING AT THE CENTRAL PLANT

When a stationary mixer is used for partial mixing of concrete (shrink-mixing), the mixing time in the stationary mixer may be no more than is required to intermingle the ingredients. After transfer to a truck mixer, further mixing at a designated mixing speed will be required only as necessary to meet the requirements for uniformity of concrete as specified for truck mixing.

II.5.D.03.5 PLANT MIX

Mixing at a central plant shall conform to the requirements for mixing at the site, Section II.5.D.03.2, MIXING AT SITE.

II.5.D.03.6 RETEMPERING

Concrete shall be mixed only in such quantities as are required for immediate use. Any concrete which has developed an initial set shall not be used. Retempering concrete by adding water or by other means shall not be permitted. Concrete that is unsuitable for placement as delivered, according to these specifications, shall be rejected, as directed by the Engineer.

II.5.D.04 HAULING AND PLACING

II.5.D.04.1 WEATHER LIMITATIONS

Except with written permission from the Engineer, construction of PCC pavement shall not be in progress or continued when a descending air temperature in the shade and away from artificial heat falls below 40° F, nor shall such construction be resumed or in progress until an ascending air temperature in the shade and away from artificial heat reaches 35° F. Unless otherwise permitted, the temperature of the mix shall not be less than 50° F nor more than 80° F at the time of placing. Material containing frost or lumps of hardened material shall not be used. Placement of concrete upon frozen ground shall be prohibited at all times.

Concreting operations shall be discontinued upon order from the Engineer due to insufficient natural light, unless an adequate and approved artificial lighting system is provided and operated.

When concrete is being placed during cold weather and the air temperature may be expected to drop below 35° F, a sufficient supply of straw, hay, grass, or other suitable blanketing material shall be provided along the work, and any time when the air temperature may be expected to reach the freezing point during the day or night, the material so provided shall be spread over the pavement to a sufficient depth to prevent freezing of the concrete. If required by the Engineer, concrete laid less than 24 hours shall also be covered by approved canvas or similar enclosures and devices capable of protecting the concrete from freezing. Any concrete injured by frost action shall be removed and replaced at the Contractor's expense.

The Contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete from the effects of rain or other precipitation. Protective material may consist of sheets of burlap, paper or plastic film. It will be the Contractor's responsibility to protect the pavement from damage, and failure to properly protect unhardened concrete may constitute cause for the removal and replacement of defective pavement at the Contractor's expense.

II.5.D.04.2 EQUIPMENT

Hauling Equipment - Truck mixers and truck agitators shall conform to the applicable requirements of II.5.D.03.3, TRUCK MIXING.

Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight, metal containers capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when needed for protection.

Paving Equipment - Slip form pavers shall be of a design that will spread, consolidate, screed and float-finish the freshly placed concrete in one complete pass of the machine.

Mechanical deck finishers shall be of a design that will consolidate, screed and float-finish the freshly placed concrete in one complete pass of the machine.

II.5.D.04.3 FORMS

All forms shall be approved by the Engineer prior to pouring concrete.

All forms shall be mortar-tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained to prevent warping and the opening of joints.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. Forms shall be designed and constructed so as to withstand the effect of vibration of concrete as it is placed.

All forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. The Contractor is responsible for removal of the forms at the proper time and shall be responsible for all damage resulting from premature removal of forms. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete the work may be ordered stopped until the defects have been corrected.

The shape, strength, rigidity, water tightness and surface smoothness of reused forms shall be maintained at all times. Any warped or bulged lumber shall be resized before being reused. The Contractor shall not reuse forms which are unsatisfactory in any respect.

In lieu of setting forms the edge of a previously placed concrete gutter section may be used as a form.

All forms shall be treated with an approved substance to prevent adhering of the concrete to the forms. Material which will adhere to or discolor the concrete shall not be used.

II.5.D.04.4 TIME OF HAULING AND PLACING

Concrete transported in a truck mixer, agitator or other transportation device shall be discharged at the job and placed in its final position in the forms within 90 minutes of the introduction of the mixing water to the cement and aggregate, or the cement to the aggregate, except that in hot weather or under other conditions contributing to quick stiffening of the concrete, the maximum allowable time may be reduced to 60 minutes. The maximum volume of mixed concrete transported in an agitator shall be in accordance with the specified rating.

II.5.D.04.5 PUMPING

Placement of concrete by pumping will be permitted provided the Contractor furnishes and uses clean equipment of sufficient size and capacity to satisfactorily handle the concrete mix specified for the project. The discharge line of the pump shall be steel or rubber pipe. Any extra costs involved for additional cement or additives required to obtain a plumbable mix shall be at the expense of the Contractor.

When concrete is placed by pumping, the operation of the pump shall produce a continuous stream of concrete without air pockets. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in a manner that will not cause contamination of the concrete or separation of the ingredients.

II.5.D.04.6 HAULING AND PLACING

The plant capacity and transporting apparatus shall be adequate to insure continuous delivery of concrete during concreting operations and shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate of delivery shall be such that the interval between the batches shall not exceed 20 minutes.

The methods of delivering and handling the concrete shall be such as will facilitate placing with a minimum of re-handling and without damage to the concrete. The concrete

shall be deposited on a moist grade or base as specified and any damage or displacement of the grade or base shall be repaired prior to the placement of additional concrete.

Placing shall be continuous between traverse joints and to the required thickness as specified. If a delay occurs in the delivery of a load of sufficient time that the concrete has begun to set, an intermediate construction joint shall be constructed in conformance with Section II.5.D.06.3, CONSTRUCTION JOINTS. At no time will concrete from one delivery be allowed to be spread to a thin layer and then covered with concrete from a subsequent delivery. When necessary, hand spreading of concrete shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the fresh concrete with boots or shoes coated with earth or other foreign substances.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full depth and on both sides of all joint assemblies by suitable means so as to preclude the formation of voids or honeycomb pockets. Vibrators shall not be permitted to come in contact with a joint assembly, the grade or a side form. The vibrator shall never be operated longer than 15 seconds in any one location.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them but shall not be dumped onto a joint assembly.

II.5.D.04.7 STRIKE OFF, CONSOLIDATION, AND FINISHING

The concrete shall be struck-off, consolidated and finished with a mechanical finishing machine, vibrating screed, or hand-finishing methods as approved by the Engineer to conform to the pavement cross-section as shown on the Plans. All irregularities shall be corrected by adding or removing concrete as needed. Slip-form pavers may be used.

Addition of water to the surface of the concrete to assist in finishing operations shall not be permitted. The surface of the concrete shall not be floated, troweled, broomed or otherwise molested while free water is on the surface.

Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab shall be carefully finished with an edger as approved.

The final surface of the pavement shall have a uniform, skid-resistant texture. The method of texturing shall be approved by the Engineer, and he may require changes in the final finishing procedure as required to produce the desired final surface texture.

II.5.D.05 CURING

II.5.D.05.1 GENERAL

Concrete shall be cured by protecting it against loss of moisture, rapid temperature change, and mechanical injury for at least 72 hours after placement. Moist curing, waterproof paper, white polyethylene sheeting, liquid membrane compound, or a combination thereof may be used. Other materials or methods for curing may be submitted to the Engineer for approval prior to the placement of any concrete. After finishing operations have been completed, the entire surface of the newly placed concrete shall be covered by whatever curing medium is

applicable. The edges of concrete slabs exposed by removal of forms shall be protected immediately to provide these surfaces with continuous curing treatment equal to the method selected for curing the slab.

The Contractor shall have at hand and ready to install the equipment needed for adequate curing before actual placement begins.

II.5.D.05.2 MEMBRANE CURING

The membrane method of curing shall be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the minimum rate of one gallon per 150 sq. ft. of surface area shall be required. The compound shall be kept agitated to prevent the pigment from settling, and it shall be applied to the pavement edges immediately after the forms have been removed. Membrane curing will not be permitted in frost affected areas on paving that will be exposed to deicing chemicals within 30 days after completion of the curing period. The compound shall form an impervious membrane when tested in accordance with ODOT TM 721.

II.5.D.05.3 MOIST CURING

Moist curing shall be accomplished by a covering of burlap or other approved fabric mat used singly or in combination. Curing mats shall be thoroughly wet when applied and kept continuously wet and in intimate contact with the pavement surface for the duration of the moist-curing period. Burlap or fabric mats shall be long enough to cover the entire width and edges of the pavement land and lapped at joints to prevent drying between adjacent sheets.

II.5.D.05.4 WATERPROOF PAPER OR WHITE POLYETHYLENE

Waterproof paper or white polyethylene sheets shall be in pieces large enough to cover the entire width and edges of the slab and shall be lapped not less than 18-inch. The paper or polyethylene shall be adequately weighted to prevent displacement or billowing due to wind, and material folded down over the side of the pavement edges shall be secured by a continuous bank of earth. Tears or holes appearing in the paper or polyethylene during the curing period shall be immediately repaired.

II.5.D.06 JOINTS

II.5.D.06.1 CONTRACTION JOINTS

Contraction joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the pavement. They shall be equal to at least one-third of the depth of the slab but not more than one-half. Contraction joints shall be constructed at approximately 15-foot intervals transverse to the centerline of the roadway and adjacent to the joints in the curb and gutter section or adjacent concrete slabs. A longitudinal contraction joint shall be placed along the centerline of the street. The contraction joint pattern in cul-de-sacs and around structures in the roadway shall conform to the patterns outlined in Standard Detail 102 or an approved equal.

Contraction joints shall be constructed using one or another of the following methods as specified in the Plans or by the Engineer:

1. Transverse strip contraction joints shall be formed by installing a parting strip to be left in place.
2. Formed grooves shall be made by depressing an approved tool or device into the plastic concrete. The tool or device shall remain in place until the concrete has attained its initial set and shall then be removed without disturbing adjacent concrete.
3. Sawed contraction joints shall be created by sawing grooves in the surface of the pavement with an approved concrete saw. After each joint is sawed, the saw cut and adjacent concrete surfaces shall be thoroughly cleaned.

Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking occurs. If necessary, the sawing operations shall be carried on both day and night, regardless of weather conditions. A standby saw shall be available in the event of breakdown.

The sawing of any joint shall be omitted if a crack occurs at or near the joint location before the time of sawing. Sawing shall be discontinued if a crack develops ahead of the saw. In general, all joints shall be sawed in sequence. All contraction joints in lanes adjacent to previously constructed lanes shall be sawed before uncontrolled cracking occurs. If extreme conditions make it impracticable to prevent erratic cracking by early sawing, the contraction joint groove shall be formed before initial set of concrete, as provided above.

4. Transverse formed contraction joints shall consist of a groove or cleft extending downward from and normal to the surface of the pavement. These joints shall be made while the concrete is plastic by an approved mechanically or manually operated device to the dimensions indicated in the Plans.

If full conformance with the above requirements is not obtained, pavement areas containing uncontrolled cracks shall be removed and replaced by the Contractor at his expense, at the direction of the Engineer.

II.5.D.06.2 EXPANSION JOINTS

Expansion joints shall be used only as specified herein and/or as directed by the Engineer. Expansion joints shall be placed at all joints where the new construction abuts and joins with existing pavement, over expansion joints in underlying concrete and opposite abutting expansion joints. A preformed, approximately ½-inch thick expansion joint material shall be used

in the expansion joints. Preformed expansion joint filler shall be provided in lengths requiring a minimum number of pieces. Joints in the filler shall be clipped or laced butt-type. The support of the filler while concrete is being placed adjacent to and in contact with it shall be firm and adequate to insure specified permanent position, and the top of the filler shall be slightly below and paralleling the finished pavement surface.

II.5.D.06.3 CONSTRUCTION JOINTS

Construction joints shall be constructed when there is an interruption in the concreting operation of sufficient time that the concrete already placed has begun to set. No construction joint shall be constructed within 10 feet of an expansion joint or contraction joint. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed by the Engineer.

At the recommencement of placing concrete the header board shall be removed very carefully to prevent disturbance to previously poured concrete. Any debris at and beyond the joint shall be cleaned out and spilled concrete removed. The new concrete placed contiguous to the joint shall closely conform to the proportions and consistency of the previously placed concrete and shall be vibrated and consolidated to a greater degree and with more care than is usual in normal construction.

II.5.D.06.4 JOINT SEALING

When required, joints to be sealed shall be filled with joint-sealing material in conformance with Section II.5.C.06, JOINT MATERIALS, before the pavement is opened to traffic and as soon after completion of the curing period as is feasible. Just before sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound, and joint faces shall be clean and surface-dry when seal is applied.

When the joint filling material is a liquid, the joint filling shall be done without spilling material on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned. The use of sand or similar material to cover the seal shall not be permitted.

II.5.D.07 SURFACE FINISH

The surface of the concrete pavement will be tested for trueness to specified grade and cross section at selected locations with a 10-foot straightedge or other approved equipment. The variation of the surface from the testing edge of the straight edge between any two contact points with the surface, shall at no point exceed 0.015-foot, except at grade changes.

Individual high points may be ground down by abrasive means provided that such grinding does not create spalling of aggregate and does not create unacceptable deficiencies in pavement thickness. The practicable extent of grinding shall not exceed 0.5-inch. Affected areas will be subject to the taking of cores to verify proper thickness, according to Section II.5.E.03, IN-PLACE SAMPLES AND THICKNESS.

II.5.D.08 CARE OF THE WORK

PCC pavement shall not be opened to traffic until 14 days after the concrete is placed, unless otherwise specified or directed by the Engineer.

The Contractor shall erect and maintain suitable barriers to protect the concrete from traffic or other detrimental trespass until the pavement is opened to traffic. If necessary, the Contractor shall maintain watchmen to insure that these barriers are not removed or destroyed and that trespass upon the pavement does not occur.

Any damage to the pavement during construction or until all work under the Contract is completed shall be repaired by the Contractor at no expense to the City.

II.5.E.00 TESTING

II.5.E.01 MATERIALS AND MIXTURE

Sampling and testing of aggregate, cement, or any of the other materials specified for determination of compliance with the specified requirements shall take place preceding addition of the portland cement to the mixer.

Aggregate shall be in conformance with the specified requirements according to the following sampling and testing procedures:

COURSE AGGREGATE

1.	Sampling	AASHTO T2
2.	Materials Passing the No. 200 - Sieve	AASHTO T11
3.	Sieve Analysis	AASHTO T27
4.	Abrasion	AASHTO T96
5.	Soundness	AASHTO T104
6.	Friable Particles	AASHTO T112
7.	Degradation	ODOT Standard
8.	Lightweight Pieces	AASHTO T113
9.	Fracture	ODOT Standard

FINE AGGREGATE

1.	Sampling	AASHTO T2
2.	Materials Passing the No. 200 Sieve	AASHTO T11
3.	Organic Impurities	AASHTO T21
4.	Sieve Analysis	AASHTO T27
5.	Mortar Strength	ODOT Standard
6.	Soundness	AASHTO T104
7.	Friable Particles	AASHTO T112
8.	Lightweight Pieces	AASHTO T113
9.	Sand Equivalent	ODOT Standard

Acceptance will be based on periodic sample taking.

When specified or directed by the Engineer, the Contractor shall furnish certified laboratory tests that the Engineer may require showing results of the specified tests at no expense to the City. When specified, the Engineer may do the sampling and/or testing of the materials as required. If evidence of noncompliance with the requirements exists, additional tests may be required to assure that the materials meet the requirements as specified at no expense to the owner.

II.5.E.02 COMPRESSIVE STRENGTH

A minimum of 4 concrete cylinders shall be taken for each 250 cubic yards, or portion thereof of concrete placed per project. The sampling and testing shall be in conformance with AASHTO T22 and AASHTO T23. 2 of each of the 4 cylinders shall be tested in 7 days and the remaining 2 in 28 days from the date of molding.

Unless otherwise specified, the City will be responsible for providing testing services. It will be the Contractor's responsibility to coordinate sampling with the City's designated laboratory.

If evidence of substandard strength exists, additional tests may be required by the Engineer. These tests may be used in lieu of previous tests for the following acceptance schedule. The costs of such additional tests and for the removal and replacement of all work found to be defective shall be the responsibility of the Contractor.

The PCC shall be accepted according to the average compressive strengths of the 4 or more cylinders taken for 28 day tests for each 500 cubic yards placed and the following acceptance schedule:

Acceptance Schedule Compressive Strength	
Pay Factor	Percent of Specified Strength
1.00	95 or higher
0.90	90 to 95
0.70	80 to 90

Whenever the percentage of the specified compressive strength falls below the level for 100% pay, the Engineer may require that the PCC be removed and replaced to meet the required specifications all at the cost of the Contractor.

II.5.E.03 IN-PLACE SAMPLES AND THICKNESS

The Engineer shall be permitted to cut samples or to take cores or to require the Contractor to cut samples or take cores from the full depth of the concrete pavement for testing purposes, and at such locations and frequencies as the Engineer determines as required for proper representation at no expense to the City. Where samples have been taken and the samples show deficiencies according to these specifications, the Contractor shall repair the cuts or cores with like material and shall make repairs to the pavement as directed by the Engineer, all at no expense to

the City. If the samples show no deficiencies, the cost of such sample taking and repairs shall be borne by the City.

Samples may be tested for specified thickness at random locations and frequencies as the Engineer determines as required for proper representation. The pavement shall be divided into 50 square yard lots, by the Engineer for the purpose of identifying areas which may be deficient in thickness. For each entire lot of pavement, the Contract unit price applicable to the pavement may be adjusted as set forth in Section II.5.F.02.1 GENERAL, if at any location in the lot the thickness of the pavement is found to be deficient by more than 0.25-inch.

If the case where a deficiency of more than 1-inch is found and the Engineer considers the deficiency serious enough to seriously impair the traffic service expected from the pavement, the area of such deficiency, together with areas as hereinafter set forth, shall be removed by the Contractor at his own expense and the removed pavement shall be replaced with pavement of the specified design, quality and thickness. If the replacement pavement is found acceptable, that area of it which replaces the actual area of deficiency will be included in the area measured for payment under the Contract. In the case the Engineer considers there is little probability of early failure of the pavement found deficient by more than 1-inch, he may permit the Contractor to elect whether to leave the deficient pavement in place without payment as set forth in Section II.5.F.02.1 GENERAL, or to remove it and to replace it with acceptable pavement as herein provided.

II.5.E.04 GRADE AND CROSS-SECTION

The specified grade and cross-section shall be checked by the Engineer using hand levels, tapes, string lines, and/or other appropriate methods prior to final PCC pavement approval.

II.5.F.00 MEASUREMENT AND PAYMENT

II.5.F.01 MEASUREMENT

When specified, quantities for PCC pavement will be measured on a square yard basis. The measurement will be based on the actual field top surface length and width, up to the specified length and width, of the PCC pavement measured to the nearest 0.1-foot and the area computed to the nearest square yard.

II.5.F.02 PAYMENT

II.5.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to PCC pavement construction performed on the Contract work under Section II.5, PORTLAND CEMENT CONCRETE PAVEMENT, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidentals necessary for all of the Contract work as specified under or covered by the Section.

Payment for leveling course rock shall be incidental to the placement of concrete pavement. All other work specified for performance under or covered by this Section not specified or listed in the proposal for separate payment, will be considered as incidental work for which no separate payment will be made.

Partial payment may be made for PCC pavement deficient in thickness according to Section II.5.E.03, IN-PLACE SAMPLES AND THICKNESS, and the following reduced payment schedule:

Deficiency in Thickness (inches)	Proportional Part of Contract Unit Price Allowed
0.00 to 0.25	100%
0.26 to 0.50	80%
0.51 to 0.75	60%
0.76 to 1.00	50%

No payment will be made for any area of pavement found deficient in thickness by more than 1-inch, even though such pavement is permitted by the Engineer to remain in place under the provisions of Section II.5.E.03, IN-PLACE SAMPLES AND THICKNESS.

II.5.F.02.2 PAY ITEMS

Pay Item Description	Unit of Measure
PCC Pavement	Square Yards

II.6 CURBS, GUTTERS, DRIVEWAYS, SIDEWALKS, AND BIKEPATHS

II.6.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for the construction of either AC or PCC curbs, gutters, combination curbs and gutters, driveways, sidewalks, bikepaths and traffic islands or separators; hereinafter referred to collectively as structures. Unless otherwise specified, these structures shall be constructed in accordance with these specification's Standard Details.

II.6.B.00 DEFINITIONS

II.6.C.00 MATERIALS

II.6.C.01 AC CONSTRUCTION

Any materials, including their composition and proportioning, involved in AC construction shall conform to the applicable requirements of Section II.4.C.00, ASPHALTIC CONCRETE PAVEMENT - MATERIALS.

II.6.C.02 PORTLAND CEMENT CONCRETE CONSTRUCTION

Any material, including their composition and proportioning, involved in PCC construction shall conform to the applicable requirements of Section II.5.C.00, PORTLAND CEMENT CONCRETE PAVEMENT - MATERIALS.

II.6.C.03 WEEPHOLES

Weepholes shall be constructed of polyvinyl chloride (PVC) pipe, Schedule 40, or approved equal.

II.6.C.04 DETECTABLE WARNING TEXTURE

Acceptable detectable warning texturing at wheelchair ramps:

Armor-Tile Cast-In-Place Tile
Approved Equal

II.6.D.00 CONSTRUCTION/WORKMANSHIP

II.6.D.01 BASE

The structures shall be placed on a base and/or subgrade which has been prepared in accordance with Section II.1.D.05, SUBGRADE and/or Section II.3, BASES.

II.6.D.02 MIX DESIGN

II.6.D.02.1 AC

When specified as a construction material for any of the structures, AC mix design shall be in accordance with Section II.4.C.09, COMPOSITION AND PROPORTION OF MIXTURES, as specified.

II.6.D.02.2 PORTLAND CEMENT CONCRETE

When specified as a construction material for any of the structures, PCC mix design shall be in accordance with Section II.5.D.02, MIX DESIGN, except as hereinafter modified.

1. The slump of the concrete mix shall be such that the finished specified structure will match the cross section as shown on the standard detail of the specified structure or as further specified on the Plans or by the Engineer. At no time shall the slump exceed 3-inch for vibrated concrete or 4-inch for non-vibrated concrete according to the requirements of AASHTO T119. The slump shall be uniform for each batch as much as reasonably possible.

2. The maximum size of coarse aggregate to be used in non-reinforced PCC structures as specified in this Section shall be 1-1/2-inch.

3. The PCC shall be so proportioned as to provide a 28 day minimum ultimate compressive strength of 3000 psi according to the applicable provisions of AASHTO T22 and AASHTO T23, unless otherwise specified.

II.6.D.03 MIXING

II.6.D.03.1 ASPHALTIC CONCRETE

Mixing of AC shall conform to the applicable requirements of Section II.4.D.03, MIXING AND DISCHARGE TEMPERATURES.

II.6.D.03.2 PORTLAND CEMENT CONCRETE

Mixing of PCC shall conform to the applicable requirements of Section II.5.D.03, MIXING.

II.6.D.04 HAULING AND PLACING

II.6.D.04.1 WEATHER LIMITATIONS

II.6.D.04.1.a ASPHALTIC CONCRETE

When AC is used, weather limitations shall conform to Section II.4.D.04, WEATHER LIMITATIONS.

II.6.D.04.1.b PORTLAND CEMENT CONCRETE

When PCC is used, weather limitations shall conform to Section II.5.D.04-†, WEATHER LIMITATIONS.

II.6.D.04.2 EQUIPMENT

II.6.D.04.2.a ASPHALTIC CONCRETE

Hauling Equipment - Hauling equipment shall conform to the applicable requirements of Section II.4.D.05, EQUIPMENT.

Placing Equipment - Any machine for extruding AC structures shall be of a self-propelling design capable of placing, consolidating and screeding the AC structures to the lines, grades and cross section specified, in an even homogeneous manner, in one pass of the machine.

II.6.D.04.2.b PORTLAND CEMENT CONCRETE

Hauling Equipment - Hauling equipment shall conform to the applicable requirements of Section II.5.D.04.2, EQUIPMENT.

Placing Equipment - Any machine for extruding PCC structures shall be of a self-propelling design capable of placing, vibrating consolidating, screeding and

float-finishing the PCC structures to the lines, grades and cross-section specified, in an even homogeneous manner, in one pass of the machine.

II.6.D.04.3 FORMS

Forms shall conform to the applicable requirements of Section II.5.D.04.3, FORMS. AC construction with forms shall meet the same requirements for forms as specified in Section II.5.D.04.3, FORMS.

II.6.D.04.4 HAULING AND PLACING

II.6.D.04.4.a ASPHALTIC CONCRETE

Hauling, placing, consolidation and finishing of AC shall conform to the applicable requirements of Section II.4.D.07, HAULING AND PLACING, II.4.D.08, THICKNESS AND NUMBER OF LAYERS, and II.4.D.09, LONGITUDINAL AND TRANSVERSE JOINTS. AC may be spread by small or special pavers or spreader boxes and may be compacted by small self-propelled rollers, vibratory compactors, or mechanical tampers. Only in the case of necessity, as determined by the Engineer, shall the mixture be spread or compacted by hand methods. The AC shall have a finish of uniform texture and shall be thoroughly compacted to a uniform dense mass.

II.6.D.04.4.b PORTLAND CEMENT CONCRETE

Hauling, placing, consolidation and finishing of PCC shall conform to the applicable requirements of Section II.5.D.04.4, TIME OF HAULING AND PLACING, II.5.D.04.5, PUMPING, II.5.D.04.6, HAULING AND PLACING, and II.5.D.04.7, STRIKE OFF, CONSOLIDATION, AND FINISHING.

PCC structures may be placed by mechanical extrusion methods or with suitable forms, as the contractor may elect.

Before final finishing is completed and before the concrete has taken its initial set, the edges of the structures shall be carefully finished with an edger as approved.

II.6.D.05 PORTLAND CEMENT CONCRETE CURING

Curing shall conform to the applicable requirements of Section II.5.D.05, CURING.

II.6.D.06 PORTLAND CEMENT CONCRETE JOINTS

II.6.D.06.1 CONTRACTION JOINTS

Contraction joints shall conform to the applicable requirements of Section II.5.D.06.1, CONTRACTION JOINTS.

Contraction joints in the structures shall be perpendicular to the structure alignment. Joints shall be placed at approximately 15-foot intervals, at the beginning and ending of curved portions of curbs, at weepholes and at any other obstructions. "Dummy" joints shall be

placed at approximately 5-foot intervals in sidewalks. Joint edges shall be tooled with approved edgers.

II.6.D.06.2 EXPANSION JOINTS

Expansion joints shall conform to the applicable requirements of Section II.5.D.06.2, EXPANSION JOINTS.

In addition a preformed approximately 1/8-inch thick expansion joint material such as heavy roofing felt (30 lb) shall be placed around poles, posts, boxes and other fixtures which protrude into the concrete structures unless otherwise waived by the Engineer.

II.6.D.06.3 CONSTRUCTION JOINTS

Construction joints shall conform to the applicable requirements of Section II.5.D.06.3, CONSTRUCTION JOINTS.

II.6.D.06.4 JOINT SEALING

Joint sealing shall conform to the applicable requirements if Section II.5.D.06.4, JOINT SEALING.

II.6.D.07 SURFACE FINISH

The surface of either AC or PCC will be tested for trueness to specified grade and cross-section at selected locations with a 12-foot straightedge and/or other approved equipment. The variations of the surface from the testing edge of the straightedge between any two contact points with the surface shall at no point exceed 0.02-foot, except at grade changes. All work shall be within 0.5-inch of true line, within 0.25-inch of established surface grade, cross-section and slope, and within 0.25-inch of specified thickness.

II.6.D.08 WHEELCHAIR RAMPS

Wheelchair ramps shall be constructed in accordance with Standard Detail 107, 107A, and 107B.

II.6.D.09 WEEPHOLES

Weepholes shall be installed through the curb section in accordance with Standard Detail 103 at locations as shown on the Plans and as directed by the Engineer. At locations where sidewalks are to be installed as shown on the Plans or as directed by the Engineer, the weep holes shall be extended to a point not exceeding 1-inch beyond the back edge of the sidewalk. A pipe coupling shall be installed at the end of the weep hole extension.

Where existing roof drains exist which originally had drained into roadside ditches or similar, these drains shall be tied into the new weepholes, the cost of such to be incidental to the weephole construction.

Weep holes shall have an inside diameter of 3-inch.

II.6.D.10 DETECTABLE WARNING TEXTURE

All detectable warning texturing shall be installed according to manufacturer's recommendations.

II.6.D.11 CARE OF THE WORK

Care of the work for any of the structures as listed in this Section shall conform to the applicable requirements of Section II.4.D.12, CARE OF THE WORK, and II.5.D.08, CARE OF THE WORK.

II.6.E.00 TESTING

II.6.E.01 ASPHALTIC CONCRETE CONSTRUCTION

Testing of AC construction of structures under this Section shall conform to the applicable requirements of Section II.4.E.00, TESTING.

II.6.E.02 PORTLAND CEMENT CONCRETE CONSTRUCTION

Testing of PCC construction of structures under this Section shall conform to the applicable requirements of Section II.5.E.00, TESTING.

II.6.F.00 MEASUREMENT AND PAYMENT

II.6.F.01 MEASUREMENT

II.6.F.01.1 CURB

Curb will be measured on a lineal foot basis along the face of curb for the actual length of specified curb constructed.

II.6.F.01.2 COMBINATION CURB AND GUTTER

Combination curb and gutter will be measured on a lineal foot basis along the face of curb for the actual length of specified combination curb and gutter constructed.

II.6.F.01.3 CONCRETE VALLEY GUTTER

Concrete valley gutter will be measured on a lineal foot basis for the actual length of specified gutter constructed.

II.6.F.01.4 DRIVEWAYS, SIDEWALKS AND BIKEPATHS

Driveways, sidewalks and bikepaths will be measured on a square yard basis for the actual area of specified thickness of PCC or AC constructed.

II.6.F.01.5 TRAFFIC ISLANDS

Traffic islands will be measured by component parts of curb and sidewalk as described above.

II.6.F.01.6 DRIVEWAY AND/OR WHEELCHAIR RAMP DEPRESSED

CURB

Driveway and/or wheelchair ramp depressed curb sections will be measured on a per each basis for each driveway and/or wheelchair ramp curb cut constructed.

II.6.F.01.7 WEEP HOLES

Weep holes will be measured on a per each basis for each weep hole actually installed.

II.6.F.02 PAYMENT

II.6.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to curb, gutter, driveway, sidewalk and bikepath construction performed on the Contract work under Section II.6, CURBS, GUTTERS, DRIVEWAYS, SIDEWALKS, AND BIKEPATHS, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

Partial payment for deficiencies in thickness shall conform to the applicable requirements of Sections II.4.F.02.2 PAYMENT DEDUCTIONS AND REJECTIONS OF HMAC and II.5.F.02.1 GENERAL.

Unless otherwise specified, crushed aggregate base as specified and required under driveways, sidewalks, and bikepaths shall be considered as incidental to the particular pay item and no separate payment will be made for it.

II.6.F.02.2 PAY ITEMS

Pay Item Description	Unit of Measure
Curb (specify PCC or AC)	Lineal Feet
PCC Curb and Gutter	Lineal Feet
PCC Valley Gutter	Lineal Feet
PCC Sidewalk	Square Yards
AC Sidewalk	Tons
PCC Driveway	Square Yards
AC Driveway	Tons
PCC Bikepaths	Square Yards
AC Bikepaths	Tons
Commercial Driveway	Square Yards

II.7 PAVEMENT REMOVAL AND REPAIR

II.7.A.00 DESCRIPTION/SCOPE

This section covers the work necessary to remove and repair a section of pavement whether it be for pavement repairs, utility cuts, or any other types of cuts necessary in a PCC or AC pavement.

II.7.B.00 DEFINITIONS

II.7.C.00 MATERIALS

II.7.C.01 ASPHALTIC CONCRETE

Any materials, including their composition and proportioning, involved in construction using AC, shall conform to the applicable requirements of Section II.4.C.00, ASPHALTIC CONCRETE PAVEMENT - MATERIALS.

II.7.C.02 PORTLAND CEMENT CONCRETE

Any material, including their composition and proportioning, involved in construction using PCC, shall conform to the applicable requirements of Section II.5.C.00, PORTLAND CEMENT CONCRETE PAVEMENT - MATERIALS.

II.7.D.00 CONSTRUCTION/WORKMANSHIP

II.7.D.01 GENERAL

All pavement removal and repair shall conform to Standard Detail 110.

Construction and workmanship of AC and/or PCC repairs shall conform to the applicable requirements of Sections II.4.D.00 ASPHALTIC CONCRETE PAVEMENT - CONSTRUCTION/WORKMANSHIP and II.5.D.00 PORTLAND CEMENT CONCRETE PAVEMENT - CONSTRUCTION/WORKMANSHIP.

Pavement cuts and repairs shall be scheduled to accommodate the demands of traffic and shall be performed as rapidly as possible to provide maximum safety and convenience to public travel. Pavement cuts and repairs are required to be included in the Traffic Control Plan. When directed by the Engineer, a temporary patch shall be constructed, at the expense of the Contractor.

When trenching is involved, the placing and compaction of the trench backfill, and the preparation and compaction of the subgrade and/or aggregate base shall be in accordance with the requirements of the various applicable sections of these specifications.

II.7.D.02 PAVEMENT CUTTING AND REMOVAL

All final cuts prior to pavement placement shall be made by saw-cut unless otherwise specifically directed. Initial cuts for removal may be made by a jack-hammer spade blade. For trenches, the saw cuts shall be made a minimum of 6-inch wider than the undisturbed base width for each side of the trench. The cuts shall be clean, vertical, and within a tolerance of 1-inch of specified line. Depths of the cuts shall be sufficient to permit the removal of pavement between or alongside them without damage to pavement or structures to be left in place. Pavement lying within the limits of said cutting shall be removed and disposed of in conformance with the applicable requirements of II.1.D.03, DISPOSAL OF EXCESS MATERIAL, as shall also any adjoining areas damaged by the cutting and removal operations.

II.7.D.03 ASPHALTIC CONCRETE REPLACEMENT

Unless otherwise approved by the Engineer, replacement of pavement in AC streets shall be with AC. The AC shall be placed to a compacted thickness not less than 4-inch or to the thickness of the removed pavement, whichever is greater.

The Contractor shall apply a tack coat to the vertical faces of the existing pavement prior to placing the asphalt concrete pavement. The application temperature of the tack coat shall be between 79°F and 160°F. The edges shall be clean and dry prior to applying the tack coat. When the air temperature is 40°F or below the Engineer may require the joint to be heated prior to the application of the tack coat.

The pavement shall be compacted in accordance with Section II.4D.00 CONSTRUCTION AND WORKMANSHIP of asphalt concrete pavement.

The joints of the asphalt concrete placement will be covered with a uniform seal coat of 6-inch overlapping each side of the joint and covered with a continuous coat of sand.

The finished surface of the AC shall match the surface of the existing pavement. The surface shall not be subjected to traffic until the material has been properly compacted and cured.

II.7.D.04 PORTLAND CEMENT CONCRETE REPLACEMENT

Unless otherwise approved by the Engineer, replacement of pavement in PCC streets shall be with PCC. The concrete shall be placed to a minimum thickness of 6-inch or to the thickness of the removed pavement, whichever is greater. The pavement shall be placed on a compacted aggregate base of minimum thickness of 2-inch which will act as a leveling course.

The Contractor shall moisten the vertical faces of the existing pavement prior to placing the concrete.

The finished surface of the concrete shall match the surface of the existing pavement. The surface shall not be subjected to traffic until the concrete has been properly cured.

II.7.D.05 REPLACEMENT OUTSIDE OF STREET AREAS

Replacement of street shoulders, driveways, curbs, gutters, walks, dikes, walls and other like structures shall consist of similar and matching construction to that of adjoining undisturbed structures, which construction shall be at least equal in all respects to that of the structures or parts of structures removed in the work.

II.7.E.00 TESTING

Testing of materials and workmanship for replacement of AC pavement and/or PCC pavement shall conform to the applicable provisions of Sections II.4.E.00 and II.5.E.00, TESTING.

II.7.F.00 MEASUREMENT AND PAYMENT

II.7.F.01 MEASUREMENT

Pavement removal and repair shall be measured on a square yard basis to the nearest square yard for the actual amount of pavement removed and replaced up to the specified amount and shall include replacement of any base specified as well as the pavement replacement.

Trench patch will be paid for at actual width up to a maximum pay limit width of the maximum trench width allowed per Section III.1.D.03.1.a, TRENCH WIDTH, plus 2-foot.

II.7.F.02 PAYMENT

II.7.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to pavement removal and repair construction performed on the Contract work under Section II.7, PAVEMENT REMOVAL AND REPAIR, by reason of Special Provisions, shall be understood to comprise full and complete compensation for

all labor, equipment, tools, materials and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

II.7.F.02.2 PAY ITEMS

Pay Item Description	Unit of Measure
Concrete Pavement Removal and Repair	Square Yards
Asphalt Pavement Removal and Repair	Tons

II.8 SURFACE TREATMENTS

II.8.A.00 DESCRIPTION/SCOPE

This section shall cover the work necessary for construction of surface treatments including thin AC overlays, seal coats, and the use of fabrics.

II.8.B.00 DEFINITIONS

II.8.B.01 THIN ASPHALTIC CONCRETE OVERLAY

The term, thin AC overlay, shall be defined as that AC overlay which does not exceed 2-inch.

II.8.B.02 SEAL COAT

A seal coat is defined as one or more applications of emulsified asphalt to an existing pavement with or without the inclusion of aggregate. The terms Fog Seal, Slurry Seal and Chip Seal will be further defined in Section II.8.D.03, COMPOSITION, PROPORTIONS OF MIXTURES, AND RATES OF APPLICATION.

II.8.C.00 MATERIALS

II.8.C.01 ASPHALT

II.8.C.01.1 THIN ASPHALTIC CONCRETE OVERLAY

Asphalt material used in thin AC overlays shall conform to the applicable requirements of Section II.4.C.02, ASPHALT CEMENT.

II.8.C.01.2 SEAL COATS

II.8.C.01.2.a EDGE SEAL

Tack coat and sand for sealing the edges of asphalt concrete paving shall conform to ODOT's Standard Specifications Section 00495, Trench Resurfacing.

II.8.C.01.2.b SLURRY SEAL

Asphalt material used in a slurry seal shall be emulsified asphalt, type CSS-1 or CSS-1h, conforming to the applicable requirements of ODOT Standard Specifications Section 00706, Emulsified Asphalt Slurry Seal Surfacing and as directed by the Engineer.

II.8.C.01.2.c CHIP SEAL

Asphalt material used in a chip seal shall be a rapid setting emulsified asphalt conforming to the applicable requirements of AASHTO M140 or AASHTO M208 and as directed by the Engineer.

II.8.C.02 AGGREGATE

II.8.C.02.1 THIN ASPHALTIC CONCRETE OVERLAY

Aggregates used for thin AC overlays shall conform to the applicable requirements of Section II.4.C.03, AGGREGATE, and II.4.C.09, COMPOSITION AND PROPORTION OF MIXTURES.

II.8.C.02.2 SEAL COATS

II.8.C.02.2.a GENERAL

Aggregates to be used in seal coats shall be crushed rock or crushed gravel, fine sand, and other finely divided mineral matter free of flat, elongated, soft or disintegrated pieces, clay, loam, vegetable matter, and other extraneous matter occurring either free or as a coating on the aggregate material. Sizes and grading of aggregate shall conform to AASHTO T27.

II.8.C.02.2.b DURABILITY

Durability requirements shall be in conformance with Section II.3.C.01.3, DURABILITY.

II.8.C.02.2.c FRACTURE

If crushed gravel is furnished, the gravel from which it is produced shall be crushed to provide at least one mechanically fractured face of at least 90% (by weight) of the material retained on the No. 4 sieve.

II.8.C.02.2.d LIQUID LIMIT AND PLASTICITY INDEX

Liquid limit and plasticity index requirements shall be in conformance with Section II.3.C.01.5, LIQUID LIMIT AND PLASTICITY.

II.8.C.02.2.e ASPHALT STRIPPING

Mineral aggregate shall have a record of proven performance, or be subject to the stripping test for Bituminous Aggregate Mixtures; AASHTO T182, using a sample of asphalt to be used in the major portion of the work. When so tested the retention of the asphalt shall be above 95%. Mineral aggregate failing to conform to this requirement will be not approved for use in the work except if approved anti-stripping additives or other approved measures correct the deficiency.

II.8.C.02.2.f GRADING

The grading of the several designated sizes that may be required in the work shall be as follows:

Sieve Size Passing	Designated Sizes			
	½-inch - No. 4	1/4-inch - No. 10	3/8-inch - No. 200 (Type I)	3/8-inch - No.200 (Type II)
	Percentages (by weight)			
3/4-inch	100			
½-inch	85-100	100		
3/8-inch			100	100
No. 4	0-15	85-100	100	90-100
No. 8			90-100	65-90
No. 10	0-4	0-15		
No. 16			65-90	45-70
No. 30			40-60	30-50
No. 40		0-5		
No. 50			25-42	18-30
No. 100			15-30	10-21
No. 100			10-20	5-15

Where a tolerance range is set forth in the above grading requirements, it shall be understood that the midpoint of the tolerance range is the target value. The

purpose of the tolerance range is only to permit occasional minor variations from the target value that are, for practical reasons, unavoidable.

II.8.C.03 MINERAL FILLER

Mineral filler shall conform to the applicable requirements of Section II.4.C.04, MINERAL FILLER.

II.8.C.04 ADDITIVES

Additives shall conform to the applicable requirements of Section II.4.C.05, ASPHALT CEMENT ADDITIVES.

II.8.C.05 ASPHALT TACK COAT

The asphalt for asphalt tack coat shall be type CSS-1 or CSS-1h conforming to the applicable requirements of ODOT Standard Specifications Section 00730, Asphalt Tack Coat and as directed by the Engineer.

II.8.C.06 FABRIC

Paving fabric will conform to ODOT Standard Specifications Section 2320 for Pavement Overlay Geotextile. Acceptable paving fabric:

Petromat, by Amoco Fibers and Fabrics Co.
Approved Equal

II.8.D.00 CONSTRUCTION/WORKMANSHIP

II.8.D.01 PREPARATION OF SURFACES

The Contractor shall repair all pot holes, cracks and distortions in the pavement as specified on the Plans and directed by the Engineer. Prior to placing the overlay or seal coat, the surface shall be cleaned of all loose material, silt spots, vegetation, dirt, dust and any other objectionable material. Any standard cleaning method used to clean pavements will be acceptable, except water flushing will not be permitted in areas where considerable cracks are present in the pavement surface.

Immediately prior to placing the overlay or seal coat, an asphalt tack coat shall be applied to the prepared surface at a rate within a range of 0.05 to 0.10 gallons per square yard. The application temperature of the tack coat shall be between 70°F and 160°F. The tack coat shall not be applied in cold or wet weather or during darkness and shall be constructed only so far in advance as is appropriate to insure a tacky, sticky condition of the asphalt at the time of placing a course thereon.

II.8.D.02 MIXING

II.8.D.02.1 THIN ASPHALTIC CONCRETE OVERLAY

Mixing of AC for overlays shall conform to the applicable requirements of Section II.4.D.03, MIXING AND DISCHARGE TEMPERATURES.

II.8.D.02.2 SLURRY SEAL

The slurry seal shall be mixed by a continuous flow mixing unit capable of delivering accurately a predetermined portion of aggregate, water and asphalt emulsion to the mixing chamber and to discharge the thoroughly mixed product on a continuous basis. The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No violent mixing shall be permitted. The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed. The fines feeder shall be used whenever added mineral filler is part of the aggregate blend.

II.8.D.03 COMPOSITION, PROPORTION OF MIXTURES AND RATES OF APPLICATION

II.8.D.03.1 THIN ASPHALTIC CONCRETE OVERLAY

The composition and proportion of mixtures for thin AC overlays shall conform to the applicable requirements of Section II.4.C.00, MATERIALS, and as specified on the Plans.

II.8.D.03.2 SEAL COAT

The composition proportion of mixtures, and rates of application for seal coats shall meet the following requirements:

Seal Coat Type	RATE OF APPLICATION PER SQUARE YARD		
	Size of Screenings	Screenings (Pounds)	Asphalt Binder (Gallons)
Slurry (Type I)	3/8-inch-No. 200	6-10	0.10-0.20
Slurry (Type II)	3/8-inch-No. 200	10-15	0.15-0.25
Chip (Fine)	1/4-inch-No. 10	12-16	0.20-0.30
Chip (Coarse)	1/2-inch-No. 4	25-35	0.25-0.35

II.8.D.04 HAULING AND PLACING

II.8.D.04.1 WEATHER LIMITATIONS

Weather limitations for work dealing with overlays and/or seal coats shall be in conformance with the applicable requirements of Section II.4.D.04, WEATHER LIMITATIONS.

II.8.D.04.2 EQUIPMENT

II.8.D.04.2.a THIN ASPHALTIC CONCRETE OVERLAY

Hauling, placing and compacting equipment for thin AC overlays shall conform to the applicable requirements of Section II.4.D.05, EQUIPMENT.

II.8.D.04.2.b SEAL COATS

Slurry Spreading Equipment - Attached to the mixer machine, as specified in Section II.8.D.02.2, SLURRY SEAL shall be a mechanical type squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained so as to prevent loss of slurry on carrying grades and crown by adjustments to assure uniform spread. There shall be a steering device and a flexible strike off. The spreader box shall have an adjustable width.

Asphalt Distributor - Asphalt distributors shall have controls for regulating and monitoring the spread of asphalt at a uniform and at a variable widths of surface up to 15 feet and at rates from 0.05 to 2.0 gallons per square yard, with uniform pressure. The variation from the specified rate of application shall not exceed 0.02 gallons per square yard. Distributor spray bars shall be full circulating and be adjustable both laterally and vertically.

Aggregate Spreader - Aggregate spreaders may be tailgate spreaders, truck attached mechanical spreaders or self-propelled mechanical spreaders as the Contractor elects. No matter what of spreader is used, though, it shall have a built-in distribution system capable of ensuring a uniform spread at the specified rate of application across the entire lane width. The spreader shall also be so designed as to prevent segregation among the aggregate sizes.

Compacting Equipment - Compacting equipment shall conform to the applicable requirements of Section II.4.D.05.4 HMAC COMPACTORS.

II.8.D.04.3 HAULING AND PLACING

II.8.D.04.3.a THIN ASPHALTIC CONCRETE OVERLAY

Hauling and placing of a thin AC overlay shall conform to the applicable requirements of Section II.4.D.07, HAULING AND PLACING.

II.8.D.04.3.b SEAL COATS

General - No loads of mixture shall be transported from the mixing plant to the point of use so late in the day as to prevent the spreading and compacting of the mixture

during daylight, unless otherwise approved by the Engineer. If placing of material during other than daylight hours is permitted by the Engineer, adequate lighting shall be provided.

Edge Seal - The tack coat for edge seals shall be placed in accordance with ODOT's Standard Specifications, Section 00495, Trench Resurfacing.

Slurry Seal - The slurry seal mixture shall be applied at the rate as previously specified in Section II.8.D.03.2 SEAL COAT with approved slurry spreading equipment as specified in Section II.8.D.04.2b SEAL COATS. The temperature of the slow setting emulsified asphalt used in the mixture shall be between 70°F and 140°F at the time of the application of the mixture. The mixture shall be placed upon a tack coat and shall have a thick, creamy consistency and shall be relatively free flowing. Once the proper consistency is obtained, changes in proportioning of the various component materials of the mixture shall be held to a minimum.

The mixture shall be spread to fill cracks and minor depressions and to ensure a uniform nonskid surface. The slurry shall be placed with a spreader box except in those inaccessible areas where hand spreading may be required. A hand drag may be required in areas of hand spreading to give the same texture as the machine spread surface.

A sufficient amount of slurry shall be applied so that complete coverage is obtained. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarser aggregate will be permitted. If oversized aggregate or foreign matter appears in the mixture, placement shall be discontinued and the aggregate rescreened to remove these materials. Streaks such as those caused by oversize aggregate shall be corrected and not left in the finished slurry seal surface.

Segregation of materials, nonuniform texture, fouled surfaces preventing full bond between layers, and other defects in materials and workmanship, determined by the Engineer as detrimental, shall be corrected by the Contractor as directed by the Engineer and the costs thereof shall be borne by the Contractor.

The treated areas shall be allowed to cure approximately 3 to 4 hours or until such time as the Engineer permits their opening to traffic.

Chip Seal - Prior to the spreading of the aggregate, the rapid setting asphalt emulsion shall be applied to the specified surface at the rate as previously specified in Section II.8.D.03.2 SEAL COAT with an approved asphalt distributor as specified in Section II.8.D.04.2.b SEAL COATS. The temperature of the rapid setting emulsified asphalt shall be between 125°F and 185°F at the time of application. The aggregate as specified in Section II.8.D.03.2 SEAL COAT shall then be immediately spread over the asphalt with approved aggregate spreading equipment as per Section II.8.D.04.2.b SEAL COATS. Hand spreading shall be used to correct deficiencies or on areas inaccessible to the specified aggregate spreading equipment. Hauling and spreading equipment shall not be allowed on uncovered asphalt emulsion.

Compaction shall proceed immediately after the placement of the aggregate material in accordance with Section II.8.D.05, COMPACTION.

II.8.D.04.4 JOINTS

Joints shall conform to the applicable requirements of Section II.4.D.09, LONGITUDINAL AND TRANSVERSE JOINTS.

II.8.D.05 COMPACTION

II.8.D.05.1 THIN ASPHALTIC CONCRETE OVERLAYS

Compaction of thin AC overlays shall conform to the applicable requirements of Section II.4.D.10, COMPACTION .

II.8.D.05.2 SEAL COATS

II.8.D.05.2.a SLURRY SEALS

Unless otherwise specified or directed by the Engineer rolling of the slurry seal is not required except at corners or sharp turn areas.

II.8.D.05.2.b CHIP SEALS

The chip seal shall be shaped and rolled until the material is interlocked, firm, bound with the underlying bituminous material, and so that the rolling does not cause undue creep or wave ahead of the roller or undue displacement.

Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh asphalt emulsion and/or aggregate mixture when required. Care shall be exercised not to displace the line and grade of edges. Steel roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of moisture and yet not to cause spotting or defacement of the surface of the chip seal.

Along curbs and walls, on walks, irregular areas, and other areas not practicably accessible to specified rollers, the mixture shall be compacted with small rollers, mechanical tampers, hand tampers or smoothing irons. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Any chip seal that becomes loose and/or broken, mixed with dirt or is in any way defective shall be subject to removal and to replacement with fresh material which shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of asphalt shall be subject to removal and replacement. Removal and replacement under these provisions shall be at the expense of the Contractor unless the Engineer determines that the defects, excesses or deficiencies are not caused by or the fault of the Contractor's operations.

II.8.D.06 FABRIC

Fabric shall be installed in conjunction with thin asphalt concrete overlays and seal coats as specified on the Plans or as directed by the Engineer.

Prior to installing the fabric on the existing pavement surface, a tack coat shall be applied at the rate of 0.35 to 0.40 gallons per square yard. The fabric shall be placed so that it is taught, wrinkle-free and laid straight within the binder area. The fabric shall be broomed in order to establish uniform contact with the binder.

Transverse and longitudinal joints shall be made by overlapping the fabric 4-inch to 6-inch. At the joints, extra binder shall be uniformly applied at the rate of 0.2 gallons per square yard.

When the thin AC overlay is being constructed over the fabric no additional tack coat is necessary. Construction of any type of seal coat over the fabric, though, shall necessitate the application of tack coat on the fabric at a rate of 0.15 to 0.25 gallons per square yard prior to the construction of the seal coat. Adequate curing time for the binder shall be allowed prior to the construction of the seal coat.

II.8.D.07 SURFACE FINISH

II.8.D.07.1 THIN ASPHALTIC CONCRETE OVERLAY

The finished surface of the layer of mixture shall be of uniform texture, smooth, free of all defects and shall match that grade and cross-section specified for the top surface. The surface will be tested for trueness to specified grade and cross section at selected locations with a 10-foot straightedge. The variation of the surface from the testing edge of the straight edge between any two contact points with the surface shall at no point exceed 0.03-foot, except at grade changes.

II.8.D.08 CARE OF THE WORK

Care of the work shall conform to the applicable requirements of Section II.4.D.12, CARE OF THE WORK.

II.8.E.00 TESTING

II.8.E.01 MATERIALS AND MIXTURE

Testing of the materials and mixture of both thin AC overlays and seal coats shall conform to the applicable requirements of Section II.4.E.01, MATERIALS AND MIXTURE.

II.8.E.02 GRADE AND CROSS-SECTION

The specified grade and cross-section shall be checked by the Engineer using hand levels, tapes, string lines, straight edges, and/or other appropriate methods prior to final overlay or seal coat approval.

II.8.F.00 MEASUREMENT AND PAYMENT

II.8.F.01 MEASUREMENT

II.8.F.01.1 THIN ASPHALTIC CONCRETE OVERLAYS AND SEAL

COATS

When specified, quantities for thin AC overlays and/or seal coats will be measured on a square yard basis. The measurement will be based on a actual field surface length and width as specified measured to the nearest 0.1-foot and the area computed to the nearest square yard.

When specified, quantities for thin asphalt concrete overlays and/or seal coats will be measured on a ton basis, to the nearest 0.1 ton, for the actual tonnage of materials delivered and placed up to 5% over the tonnage calculated from actual field area measurements and the specified thickness and density. Material receipts showing certified scale weights will be required from the Contractor.

II.8.F.01.2 FABRIC

When specified, quantities for fabric will be measured on a square yard basis, the measurement will be based on the actual field surface length and width measured to the nearest 0.1-foot and the area computed to the nearest square yard. Overlap at joints will not be considered in the computation of the area and shall be considered as incidental.

II.8.F.02 PAYMENT

II.8.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to surface treatment construction performed on the Contract work under Section II.8, SURFACE TREATMENTS, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work or which no separate payment will be made.

II.8.F.02.2 PAY ITEMS

Pay Item Description	Unit of Measure
AC Overlay (specify thickness)	Square Yards or Tons
Seal Coat in Place (specify type)	Square Yards
Asphalt Emulsion in Seal Coat (specify type)	Tons
Aggregate in Seal Coat (specify gradation)	Tons
Fabric	Square Yards

II.9. ADJUSTMENT OF INCIDENTAL STRUCTURES

II.9.A.00 DESCRIPTION/SCOPE

This section covers the work necessary for adjusting the tops of manholes, sumps, catch basins, inlets, valve boxes, meter boxes, monument boxes and similar structures to the required elevation and/or horizontal alignment as called for by the Plans or as directed by the Engineer.

II.9.B.00 DEFINITIONS

II.9.B.01 MANHOLE ADJUSTMENT

Manhole adjustment is defined as lengthening or shortening the manhole neck to a position as specified hereinafter.

II.9.B.02 MANHOLE RECONSTRUCTION

Manhole reconstruction is defined as raising or lowering portions of the manhole structure which are located below the manhole neck to a position as specified hereinafter.

II.9.C.00 MATERIALS

Unless otherwise approved by the Engineer, materials used in the adjustment of incidental structures will be new, conforming to the requirements or related work referred to herein or elsewhere in the applicable division and sections.

II.9.D.00 CONSTRUCTION/WORKMANSHIP

II.9.D.01 EXCAVATION AND BACKFILL

Excavation shall be unclassified and shall include whatever materials are encountered to the depths as shown or as directed.

When pavement is to be removed around a structure to be adjusted, the pavement shall be saw cut prior to pavement replacement. The pavement shall be replaced to the required type and grade.

Backfill shall be accomplished in accordance with the applicable requirements of Section II.1, EARTHWORK.

II.9.D.02 SALVAGE OF FRAMES, GRATES, AND COVERS

Frames, grates, and covers may be salvaged from structures to be adjusted, and if of suitable size and condition may be reused in the work upon prior approval of the Engineer, and such as are damaged or which are unfit for re-use, as determined by the Engineer, shall be replaced with similar items which are comparable in all respects with those which they are to replace and which are adequate for the intended purpose.

Salvaged components to be reused shall be cleaned of foreign material by methods that will not harm the component but will restore it to nearly new condition. Salvaged frames, covers and grates not reused on the project shall become the property of the Contractor.

II.9.D.03 RAISING TOPS OF MASONRY STRUCTURES

II.9.D.03.1 GENERAL

Any and all masonry structures which are located within the construction limits shall be adjusted to the required elevation and/or horizontal alignment as called for by the Plans or as directed by the Engineer. Manholes shall be adjusted to the required finish elevation prior to the placing of the final lift of asphalt if asphalt pavement is being constructed and prior to final finishing of the concrete if PCC pavement is being constructed. The final adjustment shall be performed by the paving Contractor.

II.9.D.03.2 GENERAL MASONRY WORK

After existing frames, covers and grates have been removed, the exposed top surface on which new mortar or concrete is to be placed, shall be chipped away to a depth of at least 1/4-inch to expose firm concrete and the new surface shall be cleaned by brushing and shall be moistened with water at the time of placing the new concrete thereon. New concrete shall then be placed to the required grade and cured at least 3 days, after which the frame shall be seated in fresh mortar and brought to the proper grade. Masonry of bricks or concrete blocks shall be raised with new bricks, blocks, mortar or combinations thereof, or with PCC, as conditions may require or permit. Concrete boxes may be lifted and placed on precast concrete box extensions on new brick or on cast-in-place concrete as may be suitable.

II.9.D.03.3 LIMITATION ON NECKS OF MANHOLES

Manhole necks are defined as that upper portion of a manhole having vertical walls and a uniform diameter or dimensions just sufficient to receive and support the metal frame. In the raising of the tops of manholes, new necks may be constructed or existing necks maybe extended; provided, however, that the total distance from the top of metal cover at its new adjusted grade to the bottom of the neck shall not exceed 18-inch.

II.9.D.03.4 MINIMUM THICKNESS OF MORTAR AND NEW CONCRETE

Mortar for building up existing masonry shall not be placed to a depth of more than 2-inch. Concrete shall not be placed to a depth of less than 3 1/2-inch. To conform to these requirements, the existing shells or walls of structures to be raised shall be cut down as necessary to provide space for the new construction.

II.9.D.03.5 PRECAST STRUCTURES

Manholes, sumps and like structures comprised of precast concrete may be raised by the use of precast concrete rings or sections conforming to the general materials requirements applicable to the existing structure with which they are used. The precast rings or section shall be set and joined to each other and to existing sections in an acceptable manner which will provide uniform bearing and positive safeguard from displacement.

II.9.D.03.6 MANHOLE STEPS

New steps consistent with Section III.4.C.07.4 MANHOLE STEPS shall be provided in the adjusted structure and in such position that the distance from the top of the adjusted structure to the top step shall not be more than 20-inch and so that the distance between new steps and between the lower new step and the upper undisturbed step will not be more than 12-inch.

II.9.D.03.7 METAL RINGS AND PLATES

Fabricated metal rings or plates may be furnished and used in the adjustment work, provided; (1) the metal and its fabrication design shall be such as will at least equal the pertinent characteristics of strength and support required of the covers or grates to be placed thereon; (2) that uniform bearing surfaces is assured; (3) positive provision is afforded against displacement when in service.

II.9.D.04 LOWERING TOPS OF MASONRY STRUCTURES

II.9.D.04.1 GENERAL

When required, any and all masonry structures which are located within the construction limits shall be lowered and adjusted to the required elevation and/or horizontal alignment as called for by the Plans or as directed by the Engineer. Manholes shall be adjusted to the required finish elevation prior to the placing of the final lift of asphalt if asphalt pavement is being constructed and prior to final finishing of the concrete if PCC pavement is being constructed.

II.9.D.04.2 CONSTRUCTION

Where the top of an existing structure of masonry construction is to be lowered, the masonry portion of the structure shall be exposed to required depth, cut off or removed to an elevation below that established for the bottom of the metal frame or cover which is to be reset on masonry and shall then be built up with mortar, concrete, brick or concrete blocks, to the required elevation and top design. The joining of new material to old, the minimum thickness of new mortar and concrete, the limitations, the curing and other details shall be as set forth in applicable portions of Section II.9.D.03, RAISING TOPS OF MASONRY STRUCTURES.

In the lowering of precast concrete structures, the entire structure may be lowered and reset at established elevation when the nature of the structure or conditions permit. If the structure is composed of precast sections or rings, such integral units may be removed and other precast sections or rings of suitable dimensions may be used in necessary form and dimensions required to achieve the required adjustment. With prior approval of the Engineer, precast sections and rings removed in the adjusting work may be re-used in other adjusting work or in new construction if in good condition, and such precast items as are not so used in the work will become the property of the Contractor.

II.9.D.05 ADJUSTING METAL STRUCTURES

Metal inlets, valve boxes, meter boxes, monument boxes and other like structures shall be raised or lowered to grade normally by resetting the entire structure on firm foundation;

or in the case of raising to a point where it would not enclose or protect its contents, by adding metal extensions of like design to the original structure; or by complete replacement of the structure with a new structure of adequate design approved by the Engineer. All final adjustments shall be by the paving Contractor and shall proceed final pavement construction to finish grade. Salvaged structures not re-used on the project shall become the property of the Contractor.

II.9.D.06 ACCURACY OF ADJUSTMENT

All structures shall be adjusted to within 0.01-foot of finished grade unless otherwise directed by the Engineer. Structures not meeting this requirement shall be readjusted according to the aforementioned requirements at the direction of the Engineer all at the expense of the Contractor.

II.9.E.00 TESTING

II.9.E.01 ACCURACY OF ADJUSTMENT

Testing for accuracy of adjustment shall be performed by the Engineer using straightedges, string lines and/or other approved equipment.

II.9.F.00 MEASUREMENT AND PAYMENT

II.9.F.01 MEASUREMENT

The measurement of the actual number of manholes, sumps, catch basins, inlets, valve boxes, meter boxes, monument boxes, and other like structures adjusted under this Section, measured as units in place, completed and accepted, shall be on a per each basis. Separate measurement will be made for each specific type or for each separate grouping of types of structures for which pay items are set forth in the bid Proposal. Required earthwork, backfill, replacement of base drains stone bases, pavements and other miscellaneous work will be considered as incidental to the adjusting work and no separate measurement thereof will be made. No separate measurement will be made under the adjustment item of new structure construction or for manhole reconstruction under the adjustment item.

The measurement of the actual number of manholes reconstructed, measured as units in place, completed and accepted, shall be on a per each basis and shall include all work as specified above.

II.9.F.02 PAYMENT

II.9.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal and for other bid items which may become applicable to adjustment of incidental structure construction performed on the Contract work under Section II.9., ADJUSTMENT OF INCIDENTAL STRUCTURES, by reason of Special Provisions, shall be understood to comprise full and complete compensation for all labor, equipment, tools, material and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, any and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

II.9.F.02.2 PAY ITEMS

Pay Item Description	Unit of Measure
Adjust Manholes	Each
Reconstruct Manholes	Each
Adjust Inlets	Each
Adjust Boxes	Each

II.10. TRAFFIC SIGNAL AND STREET LIGHTING SYSTEMS

II.10.A.00 DESCRIPTION/SCOPE

This section covers the work and materials necessary for removing, abandoning, salvaging, reinstalling, modifying, furnishing, fabricating, and installing existing and new traffic signals and street lighting structures and sub-structures as shown or directed. All materials and work shall conform to the requirements of the ODOT *Standard Specifications for Highway Construction*, Part 00900 and supporting sections, and ODOT/APWA Standard Drawing numbers BR-900 through BR-993 and numbers TM100 through TM565, unless otherwise modified herein or as directed by the Engineer.

If requirements contained in the ODOT *Standard Specifications* are in conflict with supplemental information in these documents, the requirements of these Standards shall prevail.

II.10.B.00 DEFINITIONS

II.10.B.01 CITY STANDARD SPECIFICATIONS

City Standard Construction Specifications, latest edition, herein referred to as the Standards. Copies of this publication are available from the City.

II.10.B.02 ODOT STANDARD SPECIFICATIONS AND DRAWINGS

ODOT *Standard Specifications for Highway Construction*, including supplements and drawings. Copies of this publication, as well as other ODOT specifications referenced herein are available from ODOT's Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the project is advertised.

II.10.B.03 CONTRACTOR

Contractor, as specified in these documents, refers to any party involved in the design, construction, and/or removal of traffic signals and street lighting systems for the City,

including but not limited to the developer, designer, licensed professional engineer, licensed supervising electrician, construction contractor, and sub-contractors.

II.10.C.00 MATERIALS

II.10.C.01 REGULATIONS, STANDARDS, AND CODE

All materials and workmanship shall conform to the requirements of ODOT *Standard Specifications* sections 00950, 00960, 00970, and 00990, and any sub-sections specified within these sections, unless otherwise modified herein or as directed by the Engineer.

II.10.C.02 EQUIPMENT LIST, PLANS, AND DRAWINGS

II.10.C.02.1 CONTRACTOR RESPONSIBILITIES

The Contractor shall be responsible for meeting all requirements of these Standards.

II.10.C.02.1.a DESIGN RESPONSIBILITIES

If the Contractor is responsible for the design of a project, the Contractor shall meet with the Development Review Engineer for private development projects, and the Capital Projects Engineer for public works projects, prior to beginning design, to establish location of poles and Public Utility Easements where applicable.

For private development, the Contractor shall be responsible for obtaining an electrical permit from the City Development Services.

The Contractor shall be responsible for field review of basements when light poles are to be installed in vaulted sidewalks and shall include complete foundation details on the plans.

Street lighting designs provided by the Contractor shall include average maintained street lighting levels, average-to-minimum uniformity ratio, and maximum-to-minimum uniformity ratio, unless otherwise approved.

Where possible, street lighting poles shall be located on lot lines, provided that required street lighting levels and uniformity ratios can also be achieved

Typical residential subdivision street lighting designs include 200-feet to 300-feet spacing of 30-foot wood poles, 100 watt High Pressure Sodium (HPS) fixtures with a with a minimum mounting height of 25-feet and a maximum mounting height of 27-feet, and a single or double guy mast arm or other approved support, with an overhang of approximately 10% of the curb-to-curb street width. It should be noted that the above items are typical design criteria only, and do not represent a set standard. A lighting study may be required depending on the special lighting needs of the project.

To avoid illumination obstruction by trees, a minimum of 10-feet spacing shall be maintained between street lights and new or existing trees unless otherwise approved by the Engineer.

Street lighting shall be installed at all intersections with lights mounted at a 45° angle into the intersection (typically one streetlight at local street intersections, two streetlights at collector and arterial street intersections). Street lighting shall also be installed at each “T” intersection, at the end of a cul-de-sac, and at or near a dead-end or temporary turnaround.

In street lighting systems with lights on both sides of a street, the circuitry shall be designed such that the lights on one side of the street can be de-energized without affecting the operation of the lights on the opposite side of the street.

The Contractor shall be responsible for furnishing final design and construction plans to the City for review, and partial plans as directed by the Engineer. Plans shall be prepared in a non-executable AutoCAD or dxf file digital format compatible with the current City version. Plans shall include references to at least 2 Oregon North NAD 27 State Plane Coordinates, and shall include City title blocks, quarter section numbers, project numbers, and north arrows. A City base map shall be provided upon request. Preferred scales of plans are 1-inch = 20-feet, 30-feet, 40-feet or 50-feet. Architectural scales or metric standards will not be accepted.

The Contractor shall be responsible for using ODOT *Standard Specifications* symbols for all street lighting and traffic signal plans.

The Contractor shall be responsible for contacting utility companies and determining service locations. The service locations and the name and phone numbers of the utility company contacts shall be shown on the plans.

The Contractor shall be responsible for providing a Streetscape Plan for review that provides a complete overview of all existing and proposed structures on one sheet. The Streetscape plan shall include on one drawing the following items: composite utility layers, right-of-way (ROW) lines, existing street center and edge lines, existing pavement markings, lot lines, trees, sidewalks, driveways, curbs, mailboxes, dimensions showing location of curb from ROW lines, intersection sight distance, existing signing, existing traffic signal and street lighting structures, proposed traffic signal and street lighting structure locations, dimensions showing proposed conduit location from curb line, proposed panel locations, and proposed service points.

Plans shall include proposed wiring diagrams, panel schematics, legends, and any other details necessary to provide a complete design.

Plans shall include foundation details where applicable even if City foundations are specified. Foundations must meet AASHTO 100 mph wind load with 1.3 gust factor requirements.

All street lighting and traffic signal specifications shall be separate from all other sections of project specifications and shall be complete with no need to refer to other sections for electrical work.

All street lighting related sheets, details, and calculations shall be signed and stamped with the seal of either a Supervising Electrician registered to practice in the State of Oregon or a Professional Engineer registered in the State of Oregon.

All traffic signal related sheets, details, and calculations shall be signed and stamped by a Professional Engineer registered in the State of Oregon. Final plan review shall be subject to approval by City staff prior to construction.

II.10.C.02.1.b CONSTRUCTION RESPONSIBILITIES

The Contractor shall be responsible for furnishing and installing all street lighting and traffic signal poles, conduit, wiring, pull ropes, warning tape, in-street loop detectors, and any other materials necessary for construction and operation of completed and fully functional street lighting and/or traffic control systems as shown on the plans, or as directed by the Engineer.

The Contractor shall be responsible for all coordination with utility companies including identification of a project contact person.

The Contractor shall be responsible for cost to repair or replace any materials or related infrastructure lost or damaged as a result of this project.

All street lighting and traffic control installation shall be performed by a licensed electrical contractor.

Upon completion of the work, the Contractor shall submit 2 copies of As-Built drawings and any data required to show in detail all changes made from the original plans. The information furnished shall include all modifications made and shall represent the material installed and in operation, including conduit locations, and shall be sufficiently detailed to enable maintenance crews to replace or repair any part of the street lighting system under routine or emergency maintenance by direct reference. Final project acceptance will not be given until accurate, approved As-Built drawings have been provided to the City.

The Contractor shall provide a guarantee of workmanship, materials, and performance of equipment for a period of 1 year following the final completion and project acceptance date. During the guarantee period, the Contractor shall **immediately** repair or replace faulty equipment at the City's request, and at no additional cost to the City.

II.10.C.02.2 SUBMITTALS

Materials to be used in the construction of street lighting or traffic control systems shall be submitted to the Engineer for approval using ODOT's "Green" and "Blue" sheets. The Contractor shall not order or install any material or equipment until it has been approved by the Engineer. Any material or equipment installed without approval will be rejected.

Within 30 calendar days after a contract has been awarded, or after approval of submitted plans, the Contractor shall submit to the engineer 5 copies of the following items: (a) ODOT "Blue" and "Green" sheets of all materials the Contractor proposes to use; (b) wiring diagrams for all circuits and any nonstandard or special equipment; (c) cut-sheets, brochures, technical bulletins, parts lists, service instructions, working drawings, and any other technical information relative to street lighting (including luminaries) and traffic control products proposed for use not listed in the ODOT "Blue" and "Green" sheets; and (d) designs of all poles and nonstandard pole foundations stamped by a Professional Engineer registered in the State of Oregon.

Partial submittals will not be accepted. Catalog data shall be in orderly bound form with the specific items proposed for installation clearly marked.

The Contractor shall submit to the Engineer written certification from the manufacturer that wood poles delivered are in accordance with sections II.10.C.04 and II.10.D.04 of these specifications. Any modification or deviations from this specification shall be clearly shown and marked as "Deviation from Specification."

For all base mounted poles, the Contractor shall submit to the Engineer a complete base design and drawing, stamped by a Professional Engineer licenced in the state of Oregon, that includes the following: calculations showing that all loading requirements have been satisfied; a concrete-steel foundation design; and the material, type, and sizes of all base parts including bolts and nuts.

Upon completed installation of all street lighting and traffic signal poles, the Contractor shall submit to the Engineer a written statement, stamped by a Professional Engineer registered in the state of Oregon, ensuring that the pole was installed in accordance with manufacturers guidelines and at the proper depth to provide stability for the specified wind loads as described herein.

II.10.C.03 REMOVAL, REUSE, AND ABANDONMENT OF EXISTING MATERIALS

Used materials meeting the requirements of these specifications may be reinstalled only with prior approval by the Engineer. Used materials will not be allowed for new construction projects unless otherwise approved by the Engineer.

All materials not reused in this project and that are considered salvageable by the City, including luminaries, poles and arms, signs, and cabinets, shall remain the property of the City, and shall be delivered to the City by the Contractor as directed by the Engineer. The Contractor shall be responsible for cleaning all salvaged materials and safely packaging and storing all globes, bulbs, ballasts, and all other removed appurtenances for delivery to the City at a location within Corvallis as designated by the Engineer. Cleaning and packaging of removed equipment units must be done at an off-site location outside of the City ROW. The Contractor shall provide a minimum of 24 hours advance notice to the City prior to delivering salvaged materials. All other materials removed by the Contractor shall become the Contractor's property and shall be the Contractor's responsibility for removal from the project.

Used materials, including traffic signal controller assemblies, luminaries, poles, pedestals, cabinets, and push button posts, including anchor bolts, may be furnished by the City as shown on the plans or as directed by the Engineer. Pickup and transportation of these materials shall be the responsibility of the contractor.

Payment for removal, salvaging, and reinstallation of materials will be determined by the specific contract documents for each project.

II.10.C.04 POLES

II.10.C.04.1 GENERAL

Traffic signal and ornamental street lighting poles shall be of the length specified in the plans. All street lighting poles, with the exception of ornamental poles, shall have a minimum mounting height of 25-feet and a maximum mounting height of 27-feet, unless otherwise approved by the Engineer. Direct bury poles shall be of a sufficient length to meet the manufacturer guidelines for burial depth requirements and the requirements specified herein.

All pole shafts, with luminaire and mast arm in place, shall be capable of withstanding the ASSHTO 100 mph wind loading and 1.3 gust factor, and all downward loads, including ice, without permanent deformation or failure in accordance with AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals*.

II.10.C.04.2 ANCHOR BOLTS

All nuts, bolts, and washers for pole installation shall be made from stainless steel except for anchorage hardware.

Anchorage hardware shall be hot dip galvanized on all surfaces and across their entire length after fabrication and threading in accordance with ASTM A-153. All anchor bolts shall be as specified for the type of pole and base used, and shall conform to ASTM A-449. All anchor bolts shall be threaded a minimum of 6-inches, and shall be furnished with 2 hex nuts, and 2 flat washers each above the concrete foundation to secure and level the pole. The embedded end shall be a head or nut with the threads staked (flattened so nuts will not turn) at 2 places below the nut.

Anchor bolts shall be set up by the Contractor in an accurate bolt circle by use of templates or welded up cages with each bolt vertical. Washers shall be of adequate diameter and thickness to prevent cupping or distortion when nuts are fully tightened.

II.10.C.04.3 DIRECT BURY WOOD POLES

This section governs minimum acceptable requirements for full-length preservative-treated Douglas Fir, Class 4 poles, as specified in ODOT *Standard Specifications* Section 02120.10. Poles shall be manufactured and tested according to the latest editions, revisions, and amendments to the applicable standards of ANSI and AWP, especially ANSI 05/1-1979 and AWP A3, C4, M2, P8, and P9, except as modified hereafter or as directed by the Engineer.

The wood pole face shall be permanently marked with a 2-inch diameter aluminum manufacturer's specification tag, recessed 1/4-inch into and securely nailed to the pole. The tag center shall be located 2-inches from a point 10-feet from the butt for poles up to and including 50-feet in length, and 13-feet for poles longer than 50-feet in length. The tag shall carry the manufacturer's identifying symbol, year of manufacture, size and class of pole, and treatment type.

Wood poles shall be of uniform taper from butt to top, and shall be representative of supplier's stock. Excessively crooked materials shall be grounds for rejection. All sizes pertain to poles after treatment. The top of the pole shall be cut at a 1:4 slope away from grain before treatment.

All wood poles 40-feet class 4 and larger shall be deep incised to a depth of 2-1/2-inches, from 3-feet above to 4-feet below ground line. Incising may be accomplished by using equipment specially designed for that purpose, or drilled to a previously approved pattern. If drilled, a maximum depth of 3-inches with a maximum bit size of 5/16-inch is permitted.

Wood poles shall be pressure treated with a preservative solution containing not less than 5% penta-chlorophenol by weight per assay AWP A5 and conforming to AWP A8.

Spiral grain shall not exceed one complete twist in any 30-feet; localized spiral grain shall not exceed a 1:4 slope in any 2-foot section.

Shake in the butt surface extending through an arc of not more than 90° are permitted. Shake extending through an arc of more than 90° are permitted only within a circle, the center of which is the center of the butt surface and the diameter of which is less than 2 times the average butt diameter. Shake in the top surface are permitted, provided that the diameter of the shake is less than 2 times the diameter of the top.

Maximum permitted sizes of knots for wood poles are as follows:

<u>POLE LENGTH</u>	<u>DIAMETER OF SINGLE KNOT</u>	<u>SUM OF DIAMETERS IN ANY ONE-FT SECTION</u>
45-feet and shorter	2.5-inches	8-inches
50-feet and longer	3.0-inches	10-inches

For H Class wood poles, the sum of knot diameters in any 1-foot section shall not exceed 1/3 of the pole circumference or 14-inches, whichever is the least.

Pole framing will not be allowed for street lighting poles. The only allowable holes in wood street lighting poles shall be to attach street lighting mast arms and/or guys. Wood poles that have been pre-framed to other specifications will be rejected.

Any poles found not to be in compliance with these specifications shall be rejected and removed from the job site.

II.10.C.04.4 FIBERGLASS REINFORCED POLYESTER POLES

This section governs minimum acceptable requirements for direct bury or base mounted fiberglass reinforced polyester street lighting poles, with the exception of fiberglass ornamental poles (see section II.10.C.04.6.1).

Fiberglass poles shall only be installed for street lighting on local streets and in residential areas. Fiberglass poles will not be allowed for traffic signal systems.

Fiberglass poles shall be warranted to be free of defects in materials and workmanship for a minimum period of 3 years, including fading, peeling, or flaking.

Pole shafts shall be constructed using the continuous filament winding process using catalyzed thermosetting isophthalic resin and shall contain a minimum of 65% fiberglass with 35% resin by weight. The windings shall have differing angles of laydown to provide the required strength in tension, bending, and compression. Pole shafts shall be non-conductive and chemically inert.

Unless otherwise specified, pole shafts shall be uniformly tapered, and shall be cylindrical in cross section. The wall thickness shall increase from top to bottom in proportion to the load and ground line moment requirements. The pole shaft shall be reinforced in areas of hand holes, mast arms, and other hardware attachment points. Pole shafts shall not deflect more than 5% of its length when a load of 200 lbs. is applied at a point 12-inches below the top of the shaft.

All holes or openings cut into the pole shaft shall be painted over with resin to prevent the entry of water into the glass reinforcement. Wire entry holes shall be grommeted. The pole shaft finish shall be smooth and shall be uniform and consistent throughout the shaft length. The poles shaft shall be colored to match the luminaries. The laminate shall contain colored pigment to match the color of the final coating and be of uniform color throughout the entire wall thickness.

Mounting of service and control panels on fiberglass reinforced polyester poles will not be permitted.

Base mounted fiberglass poles shall be equipped with anchor base plates for installation on concrete footings. Anchor base plates shall be fabricated from steel or aluminum and shall be arc welded to the inside and outside of the base mount around its entire circumference for maximum strength. The anchor base mount shall be bonded to the pole shaft with a high strength epoxy adhesive and finished to match the pole shaft color and texture. The anchor base plates shall have a bolt circle diameter compatible with the bolt circles specified for aluminum or steel poles of the same mounting height and shape. Steel anchor base plates and anchor base mounts shall be ASTM A-36. Aluminum anchor base plates and anchor base mounts shall be 356-T6 or 6061 T-6 aluminum alloy castings.

The finish coating of the pole shaft shall be a pigmented polyurethane finish, 1 ½ mils minimum thickness, or a winding of polyester tape over the outer fiberglass fibers prior to final painting. The finish shall be highly resistant to ultraviolet light, chemicals, salt, and extreme weather conditions. The pole shaft shall be flame resistant in accordance with ASTM D635.

II.10.C.04.5 STEEL POLES

This section governs minimum acceptable requirements for steel poles, as specified in ODOT *Standard Specifications* Section 02920.31, as directed by the Engineer, or as modified herein.

Steel street light poles may be of different material and design than steel traffic signal poles.

Steel poles for traffic signal supports shall conform to the most recent revision of ODOT/APWA Drawings BR963 and BR966. Steel poles for street lighting supports shall conform to the most recent revision of ODOT/APWA Drawings BR 956 and BR 960.

Steel pole shafts shall be fabricated from U.S. Standard 11-gauge (0.1196 inch) weldable-grade, hot-rolled, commercial quality galvanized carbon steel in accordance with ODOT Standard Specifications.

The pole shaft shall be a 1 piece construction with a full-length longitudinal high-frequency resistance weld. All steel sheets and plates shall conform to the following ASTM specifications, or an approved equal: A36, A283 Grade D, A570 (S18) Grades 33, 36, or 40; A572 (S18) grades 42 or 50, A611 (S18) grades Cor D, Type 1. The dimensional tolerances of ASTM A595 shall apply to all tapered steel tubing members.

All welding of steel poles shall be in accordance with all applicable sections of AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaries, and Traffic Signal Poles. No field welding of poles will be permitted.

Steel pole shafts shall have a uniform taper of approximately 0.11-inches of diameter change per foot of length for round poles.

No transverse joints will be permitted. The anchor base plates shall be fabricated from steel conforming to ASTM A-36.

All steel street light poles shall have a reinforced hand hole with a minimum overall dimension of 4-inches x 6-inches. The bottom of the hand hole shall be approximately 18-inches above the bottom of the pole base. The hand hole shall be positioned 90° to the bracket arm, faced away from approaching traffic in the adjacent roadway lane. A cover that matches the pole shall be provided for the hand hole, and shall be secured to the pole with stainless steel allen-head screws.

Each steel pole shall be equipped with a removable steel pole cap secured to the shaft with stainless steel screws and nut covers. Nut covers shall be attached to the shaft with stainless steel allen-head screws.

Each steel pole shaft shall have an internal lug for the purpose of attaching a grounding conductor.

II.10.C.04.6 ORNAMENTAL STREET LIGHTING POLES

Ornamental street lighting poles shall be as shown on the City standard drawings and as specified herein. Poles, castings, and fixtures which are not in conformance with these specifications will be rejected.

All equipment furnished by the vendor shall be fully compatible and interchangeable with the City's existing light poles and components. The City will solely determine

the compatibility of any and all equipment provided on City and Permit projects. Prospective manufacturers may submit pole and casting samples and drawings to the City for evaluation of compatibility prior to being qualified.

II.10.C.04.6.1 FIBERGLASS ORNAMENTAL POLES

Ornamental fiberglass poles shall be Shakespeare Composite Structures®, Madison Series type AM20, or an approved equal, unless otherwise specified in the plans or directed by the Engineer.

Pole height shall be as specified in the plans. The pole shall have a 20-inch diameter integral decorative anchor base with fluted, tapered shafts, all provided as a single unit. The pole shaft, base, and internal mounting flange shall all be molded of non-corroding fiberglass reinforced composite, pigmented throughout. A 3-inch diameter by 3-inch high aluminum tenon shall be provided for luminaire mounting. The internal mounting flange shall be provided with 4, 13/16-inch slots to accommodate 4 anchor bolts 5/8-inch x 18-inch x 3-inch in a 12-inch to 15-inch bolt circle. The fluted shafts shall be formed with 16 flutes separated by semi-flat ribs and tapered at .14-inches per foot along the fluted shaft.

The mounting flange shall be molded in 1 piece of fiberglass reinforced composite with a minimum thickness of 1/2-inch and shall be permanently bonded flush to the bottom of the base. The base of the fiberglass poles shall be grouted with a minimum of 1-inch thick non-shrink grout at the 20-inch diameter point.

A hand hole with a weather resistant access plate shall be provided in the base for wiring access and anchorage. The opening shall be no smaller than 5-inches wide at the top by 6-inches wide at the bottom by 9-inches high. The cover shall be made of fiberglass reinforced composite and shall bear the manufacturer's name. The cover shall be attached with 3 stainless steel flat countersunk hex socket head screws. Threaded inserts shall be incorporated in the pole base. If specified in the plans, a GFCI weatherproof receptacle shall be mounted 9-inches from the pole top and 90° clockwise from the hand hole.

Poles shall have a semi-gloss, black finish.

II.10.C.04.6.2 CAST IRON ORNAMENTAL POLES

Ornamental cast iron poles shall be Visco type VI-A-1-F type, or an approved equal, unless otherwise specified in the plans or by the Engineer. All parts shall be free of voids, porosity, fins and generally have a smooth sand cast finish.

The ornamental cast iron pole shall be suitable for supporting 1 H.I.D. luminaire and shall be complete in all respects. No welding will be allowed at the site at the time of erection. The pole shall be constructed straight and shall consist of the pole sub-assembly and the decorative base sub-assembly.

The pole sub-assembly shall be 11 gauge (.119-inch) wall x 5 3/4-inch O.D. x 12-feet - 0-inch in length, and conforming to ASTM Grade A36. The pole shall have 16 uniform sharply designed flutes running vertically and straight. The pole shall be tapered from bottom to top at 0.14-inch/foot. The pole shall have a 9-inch square x 1-inch base plate meeting

ASTM Grade A36 specifications. The base plate shall be welded top and bottom to the pole and have 4, 1 1/8-inch slots at 90° to each other, on a 9-inch diameter bolt circle, to accept 3/4-inch diameter anchor bolts.

The pole shall have a 3-inch x 5-inch oval hand hole located 17 1/2-inches up from the base plate to the top of the hand hole, and a grounding nut shall be welded 180° from the hand hole opening.

A steel support plate, 1/4-inch thick, conforming to ASTM Grade A36 specifications, shall be welded on the top of the pole. This plate will have a piece of 1 1/4-inch galvanized pipe x 1 1/2-inch long and with external N.P.T. threads and shall be welded to top plate. A galvanized lock nut will be furnished for each pole to attach decorative cast iron ballast holder.

4 galvanized steel anchor bolts, 3/4-inch diameter x 24-inches long x 4-inch hook, conforming to ASTM A307 complete with 2 galvanized washers and 2 galvanized hex. nuts shall be supplied with each pole.

The decorative base shall be constructed of ASTM A48-83, Class 30 gray iron and comprises 3 parts, resembling the VISCO "A" base assembly. The lower base section shall be 20-inch in diameter, and shall be designed to fit around the pole base plate. The upper base section shall be designed to fit around the pole and match with the lower base section, and shall have a removable access door that is positioned to line-up with the hand hole opening in the pole. The base collar shall fit around the fluted pole and shall have 16 even serrations to match the flutes in the pole. The overall height of the base, when assembled, shall be 32-inches. The access door shall be secured to the base with 2 stainless steel tamper-proof machine screws.

All surfaces (interior and exterior) of ornamental lighting standards shall be painted prior to shipment with 2 coats of lacquer resistant, phenolic modified alkyd, red oxide, type RODDA: Barrier III Rust Inhibitive Primer, or an approved equal. The paint shall be applied using the method recommended by the manufacture. Minimum dry film thickness of primer paint shall be 3 mils.

After installation, all exterior surfaces shall be painted with 2 coats of Antique Black, pigmented, semi-gloss, weather resistant polyurethane, silicone resin modified, long oil synthetic alkyd enamel, type RODDA: Powrkote, or an approved equal. The paint shall be applied using the method recommended by the manufacture. Minimum dry film thickness of the exterior enamel shall be 3 mils. The total dry film thickness of paint on exterior surfaces (primer paint plus exterior enamel) shall be 6 mils. The Contractor shall post "WET PAINT" signs near each pole until the paint has dried sufficiently.

II.10.C.05 CONDUIT, JUNCTION BOXES, CABLE, AND WIRE

II.10.C.05.1 GENERAL

Locations of existing conduit shown on drawings are approximate only. The Contractor shall field verify any additional conduit that may be required. Payment for supplying and installing any additional conduit will be determined by the specific contract documents for each project.

High Density Polyethylene Conduit (HDPE) conduit conforming to ODOT *Standard Specifications* may be used for street lighting systems and low voltage (< 110 volts) traffic signal systems. The conduit shall lay flat when unwound and not assume an exaggerated spiral configuration.

All conduit in foundations shall be rigid galvanized steel conduit.

Intermediate Metallic Conduit (IMC) shall not be used for any street lighting or traffic signal systems.

All junction boxes and covers shall be meet ODOT *Standard Specifications* for type and size. Street light junction boxes and covers may be polymer concrete, as approved by the Engineer. All junction box covers shall be clearly and permanently labeled as either "Traffic Signal" or "Street Lighting."

Factory supplied striping of conductors will be accepted when the required color insulation is not available. Color tape will not be accepted as an alternate for wire insulation color coding. Wire insulation color of street lighting circuits for 120 volt line distribution shall be black and the neutral conductor shall be white. For 2 phase 240 volt line distribution, 1 conductor shall be black and the other conductor shall be red. Ground conductors shall be green insulated or non-insulated stranded wire. When 2 circuits are run in the same conduit, the second pair of conductors shall have 1 blue and 1 brown conductor. Alternate or additional colors may be used as approved by the Engineer.

The Contractor shall use backer rod material and hot-melt loop sealant equivalent to those listed on ODOT's QPL list.

II.10.C.05.2 STREET LIGHTING CONDUIT, JUNCTION BOXES, CABLE, AND WIRE

Street lighting conduit shall be 2-inch minimum and sized in accordance with National Electric Code (NEC). Buried non-metallic street lighting conduit shall be Schedule 40 PVC or HDPE as noted above. Exposed non-metallic street lighting conduit shall be Schedule 80 PVC.

All non-metallic street lighting conduit, with the exception of service conduits, shall have 1 yellow #12 AWG conductor installed as a "tracer" wire for future locating purposes.

All wire used for street lighting (except overhead ACSR wire and wire used inside of luminaries) shall be type UF cable, stranded copper single conductor wire, and shall not be smaller than No. 10 AWG or larger than No. 2 AWG. THWN wire will not be allowed. Street lighting wiring shall be sized to provide a maximum voltage drop of 2% from the utility service point to the panel, and a maximum voltage drop of 3% from the panel to the light farthest from the panel on each circuit. The City reserves the right to request copies of the Contractor's voltage drop calculations.

Street lighting junction boxes shall be located at each light pole. Covers for junction boxes shall be constructed of heavy duty, skid resistant steel or polymer concrete material

conforming to ODOT *Standard Specifications*, and shall bolt to the junction box. Street lighting junction box cover surfaces shall be marked "Street lighting."

II.10.C.05.3 TRAFFIC SIGNAL CONDUIT, JUNCTION BOXES, CABLE, AND WIRE

Traffic signal conduit shall be rigid metallic conduit for all street crossings and high voltage (greater than 110 volts) systems. Non-metallic conduit may be used for low voltage (less than 110 volts) traffic signal systems only.

Traffic signal wire shall be as specified in the Plans. Aluminum conductor wires shall not be substituted for copper wires at any time.

Traffic signal aerial interconnect cable shall be figure-8 type 22-AWG, and shall comply with REA specifications PE-38, except that the cable shall be gel filled. The entire cable within the outer jacket shall be filled with a petrolatum-polyethylene gel filling compound as specified for REA specifications PE-89 cable. Underground interconnect cable shall be 22-AWG, and shall comply with REA specifications PE-89. Aerial and underground interconnect cable shall be 12-pair or 25-pair as shown on the plans. Interconnect cable shall not be spliced.

Wire used for traffic signal loops shall be No. 14 XHHW conforming to IMSA Specification No. 51-3-1984, except that the XHHW wire shall be encased in a polyvinyl chloride or a polyethylene tube, meeting the requirements of IMSA Specification No. 51-5-1985. The color of the encasing tube shall be yellow, orange or red.

Heat-shrink tubing shall be listed as UL486, 90 degree C, 600V, constructed of homogeneous polyolefin having an internally applied sealant. Heat shrinkable tubing shall be used on individual wire splices and over the entire cable.

RG59U Coax video detection wire shall be 75 ohm, 20 gauge solid copper wire that is 10.50 ohms or less per 1,000 feet, with a 95% braided copper shield. Insulation shall be PVC with a .242 nominal O.D. All coax wire shall be run un-cut and un-spliced from controller cabinet to the video camera location.

II.10.C.06 CABINETS

II.10.C.06.1 GENERAL

All cabinets shall meet ODOT *Standard Specifications* for amperage, voltage, number of breakers, meter base, pedestals, and covers. All cabinets shall be weatherproof, rated as NEMA type 3R, and constructed as shown on the plans.

All equipment locations shown on the plans are approximate only. Exact locations will be established by the Engineer at the time of installation.

Pedestal-type cabinets shall be constructed with an open-bottom and a bottom frame that can be employed to bolt the unit to a concrete pad at a minimum of four points. All working hardware shall be stainless steel. All metal and non-hardware metal parts shall have all slag, burrs, and rough spots cleaned and ground smooth. These service enclosures shall be

delivered to the site complete with all equipment installed and wired for correct operation. Arrangement of equipment and wiring shall be in general conformance with the plans and details. All work on the construction of the service cabinets and panels shall be by a UL listed facility, and the service enclosures shall carry a UL label of approval for use as “service entrance equipment.”

Panels controlling 2 or more circuits shall have a schedule affixed to the interior of the cabinet which shall clearly indicate the function (i.e. Street Lighting or Traffic Signal) and pole number of each pole that is connected to each circuit breaker. Each circuit breaker shall be numbered or otherwise identified.

II.10.C.06.2 STREET LIGHTING CABINETS

All street lighting systems shall be controlled by a free-standing dead front-type panel suitable for post mounting or base mounting, as specified on the plans. Street lighting service cabinets shall be 16 gauge sheet steel hot-dip galvanized after fabrication in accordance with ASTM A 385 and ASTM A 386, or 14-gauge 304 stainless steel or aluminum. Cabinets not made of stainless steel shall be powder coat painted.

A 14 gauge stainless steel nameplate with the words “Street Lighting” inscribed in letters approximately 3/8-inches high shall be attached to the door with a minimum of 6 stainless steel, tamper proof fasteners.

II.10.C.06.3 TRAFFIC SIGNAL CABINETS

All traffic signal cabinets shall be stainless steel and shall meet ODOT’s *Standard Specifications*. Pole mounted or painted cabinets will not be allowed for traffic signal service or control panels.

The Contractor shall provide a stainless steel service meter cabinet with service to the meter base and service panel. The service meter cabinet shall be a Circle W120V or Tessco 120V or Fouch 120V type, and shall be equipped with a 50 amp circuit breaker for traffic signal service, a 30 amp circuit breaker for street lighting service, and a 20 amp circuit breaker with a spare 2-inch stub for future use. The Contractor shall contact the City prior to construction for a temporary service permit.

II.10.C.07 PHOTOCCELL DEVICES

All street lighting and traffic signal photocell devices shall meet ODOT *Standard Specifications*. The Contractor shall be responsible for submitting an ODOT *Blue and Green Sheet* for all photocells proposed for use. All components of the solid state photoelectric control shall be housed in a weatherproof, locking type, high impact resistant, ultraviolet stabilized polypropylene container. Twist lock blades shall be solid brass.

Photocells for ornamental street lighting systems shall have a field adjustable and automatic ON/OFF switching photo control that is set to go on at dusk, and off at dawn, with a time delay feature to prevent false switching. The housing for the photocell shall be self-contained, die-cast aluminum, that is resistant to moisture, vibration, or temperature change.

II.10.C.08 LAMPS, BALLASTS, AND LUMINARIES

II.10.C.08.1 GENERAL

Luminaire mast arms for wood poles shall be hot-dipped galvanized steel and shall be constructed in accordance with ASTM specification A-36. Arms shall be upswept and formed from 2-inch steel pipe, unless otherwise specified on the plans or directed by the Engineer. Standard mounting brackets shall fit all wood poles. The arm length shall be as shown on the plans, and shall be designed to support a luminaire with an effective projected area of 4 ft² and a weight of 80 lbs.

Luminaire mast arms for steel poles shall be either anodized aluminum or galvanized steel matching the pole and luminaire assembly. Painting of mast arms will not be allowed.

II.10.C.08.2 STREET LIGHTING LAMPS, BALLASTS, AND LUMINARIES

Street lighting lamps, ballasts, and luminaries shall be in accordance with ODOT *Standard Specifications* Section 00970, unless otherwise modified herein or as directed by the Engineer.

Standard street lighting luminaries shall be General Electric, M-250R2 type, 100 watt, 9500 lumens, 120 volt High Pressure Sodium (HPS), ballast type normal power factor reactor or lag, with IES distribution medium cutoff type III optics, cobra head style clear polycarbonate lens, or approved equal.

II.10.C.08.2.a ORNAMENTAL STREET LIGHTING LAMPS, BALLASTS, AND LUMINARIES

Ornamental street lighting fixtures shall be Moldcast Washington Contracline type, with a black TGIC powder coat finish, unless otherwise specified in the plans or directed by the Engineer.

The acorn globe shall be rotationally molded, U.V. stabilized clear acrylic with random linear diffusing ribs. The cast aluminum top finial shall secure the upper globe and band to the lower globe section and globe base, and shall come complete with glued on gasket. The top section of the globe shall be affixed to a spun aluminum decorative and shall be removable for access to the lamp and ballast. The extruded aluminum decorative band shall come complete with extruded silicone rubber gasket, lower globe section and globe base in an overlapped, gasketed assembly to assure weather-tight and bug-tight operation.

The optical system shall consist of a multi-tiered assembly of specular Alzak reflectors. The inner and outer reflecting surfaces of each tier shall be separately contoured so as to produce an optically designed distribution of light from a series of single and dual reflectors. The system shall provide increased intensities at a candlepower peak occurring from 65° to 70° from vertical, and a sharp reduction of glare at normal viewing angles.

All ballasts shall be certified by electrical testing laboratories to conform to Certified Ballast Manufacturer's specifications. Ballasts shall be high power factor, CWA, suitable for temperatures starting at -20° F. The ballast shall be integrally mounted with the cast aluminum base. The ballast shall be removable and pre-wired, and shall meet the requirements for fixture light output, reliable starting, radio interference, total harmonic distortion, electromagnetic interference, and dielectric rating.

The lighting fixture shall be secured to the pole with 6 stainless steel screws, and shall be supplied with a tenon adaptor that slips over a 1-1/4-inch OD by 2-inch long tenon.

The lighting fixture shall come with a Dark Sky Shield (DSS) that allows for zero uplight, unless otherwise specified in the plans or directed by the Engineer.

II.10.C.08.3 TRAFFIC SIGNAL LAMPS, BALLASTS, AND LUMINARIES

Traffic signal lamps, ballasts, and luminaries shall be in accordance with ODOT *Standard Specifications*, Section 00990, unless otherwise modified herein or as directed by the Engineer.

Traffic signal indicators shall be LED screw-in type only, and shall bear a UL label (or Oregon approved equivalent).

The red and green ball and red and green arrow shall meet ITE incandescent lamp standards for color and light output.

All luminaries shall have a manufacturer's name plate as an integral part of the housing. The name plate shall include the manufacturer's name, model number, hook-up diagram, power supply data, and the load in watts that the control unit is capable of operating.

All luminaries of 150 watts or smaller shall be equipped with a normal power factor reactor ballast and shall be wired for 120 volts, unless otherwise specified on the plans.

II.10.C.09 TRAFFIC SIGNAL INDICATION MATERIAL, MOUNTING HARDWARE, HEADS, AND DETECTION DEVICES

Traffic signal and pedestrian heads, backboards, and housings (including doors and hoods) shall be made of black polycarbonate material on all sides, and shall be sized according to ODOT *Standard Specifications*. All parts shall be finished inside and out according to ODOT *Standard Specifications* Section 00960.48, and shall be clean, smooth, and free from flaws, cracks, blow holes, and other imperfections.

The Contractor shall furnish tri-stud adapters with two backing washers for all traffic signal assemblies, omitting the neoprene washer/gasket. The seals between the tri-stud and the signal head shall be sealed with silicon.

All fasteners shall be Type 304 or 316 stainless steel.

All red, amber, and green vehicle signal faces shall be City approved LED.

Locking devices shall be twist-lock (one or two per section) or wing nut (one per section).

Backboards shall have a 5½ inch border.

Traffic signal circuit overhead terminal cabinets shall be 6-inch x 8-inch x 18-inch in size, and shall be provided with two terminal strips.

Vehicle signal heads shall have the hole in the bottom plugged with a standard plug and lock nut, and a 1/8-inch hole drilled into the plug for drainage.

Traffic signal controller and cabinet shall be a Model 170E, 8-phase Micro-computer signal controller, or an approved equal. The signal controller shall have the following required modules: 1 each Model 210 Conflict Monitor; 2 each 242 DATA COLLECTION Isolator modules for pedestrian detection; and 1 each full duplex Communication module for inter-connect (model 400 modem). Load switches shall be Traffic Sensor Corporation TSC Model 300 with modular SSR's or approved equal. An auxiliary out-put file shall be provided with the cabinet. The cabinet with riser shall be brushed aluminum Model 332 or approved equal.

Overhead interior illuminated traffic control signs shall be 30-inches x 36-inches in size, and shall be complete with plumbizer types. See ODOT drawing TM412 for face designations and details.

A Battery-Backed Emergency Power Module, Power Sentinel 200 by Electro-Tech, or approved equal, shall be provided and installed for all traffic signal systems.

A Radio Interconnect "Gina" model 5000 NV, or approved equal, shall be provided and installed for all traffic signal systems. The radio interconnect antennae shall be located as shown on the Plans.

Pedestrian signals shall be square, 1-way, single section, clam shell mounted, with symbol indicators (hand/man) and an ODOT approved LED retrofit kit, such as the Indicator Control Corporation No. 7090 type, or an approved equal.

Pedestrian push buttons shall be H-Bracket type, constructed of brass or other nonrusting metal alloy, and shall be chrome-plated. Push buttons shall be equipped with an instruction sign having an arrow pointing to the crosswalk for which it is intended.

Audible Pedestrian Signals (APS) shall be a Traconex or Novax type, or an approved equal, in accordance with ODOT *Standard Specifications* Section 00990.42 unless otherwise directed by the Engineer.

Loop detectors shall use multiple channel scanning, tuning from 0 to 2,000 micro henries, and have 8 sensitivities. Controller to be supplied with Wapiti HCL-II software and appropriate EPROM.

Sealant for loop wire and loop feeder pavement slots shall be in accordance with ODOT Standard Specifications and be listed on the Qualified Products List (QPL), or an approved equal.

Emergency Vehicle Detection Equipment shall be an Opticom Emergency Vehicle Traffic Signal Preemption with 4 model 711 detectors, detector cables, and two 3M Model 752 discriminator modules, or an approved equal. Detectors shall be capable of being mounted on mast arms.

II.10.D.00 CONSTRUCTION/WORKMANSHIP

II.10.D.01 GENERAL

In addition to meeting the criteria in these documents, all workmanship shall be completed to a journey level quality or better. Workmanship not meeting this quality shall be removed and replaced, as directed by the Engineer, at the expense of the Contractor.

All street lighting and traffic signal equipment, conduits, and foundations shall be located in public ROW, public utility easements, or dedicated easements.

Street lighting service cabinets may be located in dedicated easements or in sidewalk areas.

Existing street lighting and traffic signal conduit locations shown on the plans are approximate. Exact locations shall be field verified prior to start of work.

The Contractor shall conform to City Standards for all pruning necessary to complete the work. It is the Contractor's responsibility to remove any trimmed vegetation from the work site.

II.10.D.02 EXCAVATION

The Contractor shall protect all existing pipes and conduits that become a part of a foundation, as directed by the Engineer or local utility company. Hand digging may be required.

All underground conduit runs, including stubs, shall be placed with a minimum of 30-inches and a maximum of 42-inches of cover below the surrounding surface. Stub conduits shall extend 18-inches behind the face of the curb.

Special precautions shall be taken when installing conduits in the vicinity of NW Natural Gas Company mains. These mains are protected by a cathodic protection system, and any contact with electrically grounded conduits will interfere with this cathodic protection system. The Contractor shall maintain a minimum of 12-inches of separation from gas mains where practical. If this is not possible, the Contractor shall notify NW Natural Gas Company so that they can insulate the conduit from the main while the trench is open.

Trenches for conduit shall be constructed no closer than 1-foot away from the gutter face.

Where sidewalk, driveways or roadways must be cut to facilitate conduit installation, the Contractor shall conform to the applicable requirements of the City Standards).

Any AC or PCC removed or damaged during construction shall be replaced within 3 working days after the street lighting or traffic signal work has been accepted.

A temporary minimum 2-inch thick cold mix patch shall be constructed and maintained at the end of each day's construction activities for trenches located across all sidewalk, street, and travel areas, unless otherwise approved by the Engineer.

In order to avoid damage to existing utilities, the excavation for foundations may require hand or vacuum methods.

II.10.D.03 FOUNDATIONS

Concrete for foundations shall be Minor Structure concrete ($f_c = 3000$ psi). Foundations shall be a continuous concrete pour, unless otherwise approved by the Engineer. Foundations shall not be contaminated with foreign material during concrete pour.

No adjustment of anchor bolts shall be made after the concrete has set. Any adjustment made may be cause for foundation rejection. Rear clearance shall be maintained during concrete pour.

Where unusual soil conditions or base installation occur, the Contractor shall increase the base dimensions, provide special bases, or provide additional reinforcement, as directed by the Engineer.

Pre-cast footings will only be accepted for those projects where they have been approved and are clearly indicated on the plan set.

Installation of pre-cast concrete pole bases shall be on undisturbed native material. All disturbed material shall be removed from the excavation of the pole base. Over-excavation shall be replaced by class 2200 concrete backfill at no additional expense to the City.

Installation and backfill of pre-cast concrete pole bases shall be in accordance with the manufacturers recommendations and stamped engineering drawings, and shall be done only with the Engineer present. Any precast concrete pole bases that are installed without the Engineer present shall be removed by the Contractor and reinstalled and back-filled with the Engineer present at no additional expense to the City.

Poured in place foundations shall be poured against native earth conditions. If the foundation is over-excavated, the entire area of over-excavation shall be backfilled with concrete when the foundation is poured. Cylindrical type framing will not be accepted unless unstable earth conditions require it, and then only at the discretion of the Engineer. When cylindrical framing is required, the framing shall be constructed from a section of steel culvert or approved equivalent. No paper sonotube products will be accepted for use on foundations for street lighting projects. Grout shall be non-shrink high early strength (non-ferrous) type with a minimum compressive strength of 5000 psi.

II.10.D.04 POLES

All poles shall be erected plumb and true, and in accordance with the manufacturer's specifications and ODOT standard specifications.

The City will provide the Contractor with an identification plate to be installed on each pole. The plate shall be located 5-feet above the adjacent roadway and positioned so it is viewable from the street side.

Street lighting poles shall be centered in the planting strip or placed a maximum of 30-inches from the curb face to the center of the pole. If no planting strip is available, street lighting poles shall be placed directly behind the sidewalk in the Public Utility Easement. Street lighting poles shall not be located in sidewalk areas unless otherwise approved by the Engineer. Street lighting poles shall be placed a minimum of 5-feet from driveway aprons.

All direct bury poles shall be installed in undisturbed soil only, unless otherwise approved by the Engineer.

All poles that are not direct bury type shall be securely tightened down on anchor bolts. Dry-pack non-shrink mortar (grout) shall be placed under the pole base plate, base casting (where applicable), and around the conduits and ground rod, and shall have a 1/2-inch diameter drain hole located at the low point to prevent water accumulations in the base. Grout shall fill all voids under the base and shall be neatly finished where exposed. Excess grout shall be cleaned from the base casting before painting and none shall show on painted surfaces. Dry-pack non-shrink mortar shall consist of a 1:3 mixture of cement and fine sand with just enough water so that the mixture will stick together when molded into a ball by hand and will not exude moisture when so pressed.

II.10.D.05 CONDUIT, JUNCTION BOXES, CABLE, AND WIRE

II.10.D.05.1 GENERAL

All conduit in foundations shall be rigid metal conduit. All conduit ends in junction boxes or foundations shall have a 1-inch clearance from other conduits, rods, pole walls, or box walls.

Conduits in new development areas shall have a minimum "skin to skin" separation distance of 1-foot for perpendicular crossings, and 7-feet for parallel crossings of all City water, storm, and sewer lines, unless otherwise approved by the Engineer. Approved crossings not meeting these requirements shall be completely encased with concrete fill.

Where new conduit is specified to be installed in existing foundations, the conduit shall be installed by carefully cutting a slot in the foundation, installing the required conduit and patching the opening with grout. New conduit may also be installed by lifting the existing pole and boring a hole in the foundation with a core drill. The new conduit shall extend far enough into the base of the pole to allow attachment of a ground bushing. The new conduit shall be grounded to the ground lug inside the pole with No. 6 copper ground wire. Care shall be taken not to damage the surrounding foundation and reinforcing during these operations. The use of pavement breaking type equipment will not be permitted.

All open-excavation underground conduit runs shall be marked by installing an underground marking tape directly above the conduit. The underground marking tape shall meet the requirements of ODOT *Standard Specifications* Section 00960.42(e) with the exception of the following: (a) the underground marking tape may be either red or yellow polyethylene film; and (b) the underground marking tape shall be placed at 12-inches plus or minus 1-inch above the conduit.

Conduit runs shall be continuous between any two poles or junction boxes and cabinets.

Conduit runs shall be installed with as few degrees bend as possible. The sum of all bends in any single conduit run shall not exceed 270°, unless otherwise approved by the Engineer. Rigid steel factory 90° bends will be allowed for conduit risers into junction boxes and foundations only. All other bends shall be 45° or less or shall be large radius bends as approved by the Engineer. Bends performed on the job or in the shop shall be rigid galvanized conduit conforming to ODOT *Standard Specifications* Section 02920.10(a) or (b) if the bend is 45° or more, unless.

Conduits shall be run under curbs without cutting the curbs. Where possible, conduit shall be pushed under existing sidewalks or driveways without cutting the concrete. Where conduits have been pushed under existing curbs, backfill shall be approved self-compacting material.

Only service conduit for street lighting may be mounted on the outside of wood poles, unless otherwise shown on the plans or approved by the Engineer. Mounting materials shall meet ODOT *Standard Specifications*.

For conduits that have conductors installed, the conduit ends shall be sealed with an approved plastic fiber and duct seal after conductors have been installed. For conduits that do not have conductors installed, the conduit ends shall be sealed using approved insulated ground bushings and sealed with duct tape. A closed cell polyethylene plug shall be installed in all conduits which terminate less than 20-inches above ground level to prevent moisture and foreign objects from entering the conduits. All conduit ends shall be sealed using care to notch the plug to encase conductors and cables to achieve a secure seal. The plugs shall be used continuously during all stages of construction to assure the conduits are kept clean and free of foreign materials. All closed cell polyethylene plugs shall meet or exceed the following specifications:

Density = 2 lb/ft³
Tensile strength = 25 psi
Water Absorption = 0.5% by volume
Compression Deflection = 25% at 8 psi
Compression Recovery = 90% per minute

Plug diameters shall be 1/4-inch larger than the conduit diameter for conduit sizes from 1/2- to 1 1/4-inch and shall be 2- to 3-inches long. Plug diameters shall be 0.5-inches larger than the conduit diameter for conduit sizes from 1 1/2- to 4-inches. Plugs for 1 1/2-inch to 2 1/2-inch conduits shall be 3-inches long. Plugs for 3- to 4-inch conduits shall be 4-inches long. Approximately 1/3 of the plug length shall be exposed after installation. Plugs shall be Molded Plug© or approved equivalent.

All conduit noted on the plans for future use with no conductors installed shall have a 1/4-inch poly pull rope installed to provide 40-inches of slack at each end of the conduit run.

Any pull ropes utilized by the Contractor shall be replaced with a new poly pull rope. All non-metallic conduit installed for future use shall also have one yellow #12 AWG conductor installed (as a “tracer” wire for future locating purposes).

Conduit outlets shall be no closer than 4-inches from the bottom of the box lid and at least 2-inches above the box gravel fill.

Wiring color shall conform to ODOT Drawing No TM421.

All street lighting and traffic signal wires shall be pulled into conduits by hand. The use of winches or other power-actuated pulling equipment will not be permitted. At least 5-feet of slack shall be left for each wire at each pole, at least 3-feet of slack shall be left at each junction box, and at least 6-feet of slack shall be left at each traffic signal cabinet, as measured from the end of the wire to the end of the conduit.

All wiring shall be made up and insulated promptly after installation of conductors. Wire shall not be pulled in until all bushings are installed and raceway terminations are complete. Wire shall not be left extending out of exposed conduit stubs or incomplete raceways where subject to mechanical injury.

All splicing shall be kept dry at all times. Small diameter electrical wire splices shall be made using a high pressure compression type solderless connector to securely join the wires both mechanically and electrically. Large diameter wire splices or multi-wire connections shall be made using a silicon bronze split bolt connector. Splices located in junction boxes, pole bases or other similar locations shall be made moisture and water proof by using a heat shrink tubing with pre-applied sealant. Silicon caulk shall be used to seal the space between adjacent wires before heat shrinking the tubing.

All field connectors to controller cabinets shall be made using approved crimp-type spade connectors.

Junction boxes shall be flush with finished grade or ground line and located at the approximate location shown on the plans, unless otherwise directed by the Engineer. In no instance shall there be more than 197-feet between access points.

In junction boxes with multiple circuits, all wires shall be clearly tagged or color coded according to ODOT *Standard Specifications* for permanent identification.

All junction boxes shall be located installed in sidewalk sections, parallel to and offset 6-inches from the back of the sidewalk and from any adjacent joint.

Cracked junction boxes or lids will be rejected and shall be replaced prior to job completion.

All rigid conduit in junction boxes shall be grounded.

For services and cabinets, a ground rod shall be installed within the cabinet base opening. For metal poles, a ground rod shall be installed adjacent to the excavated foundation.

The top of the ground rod shall be centered and extend above the foundation for attachment to the grounding circuit, and shall be the same elevation as the top of the conduit.

In all nonmetallic type conduit, a continuous bond/ground wire shall be run between all poles, pedestals, posts, and cabinets. Bond wires are not required (a) at traffic signal installations where the conduit contains only loop feeders, emergency vehicle preemption cables, or DATA COLLECTION interconnect cable; (b) where nonmetallic conduit is to be installed for future conductors; or © where only low voltage DATA COLLECTION currents are present.

II.10.D.05.2 STREET LIGHTING CONDUIT, JUNCTION BOXES, CABLE, AND WIRE

Street lighting electrical systems may be housed in traffic signal cabinets, provided that the street lighting system is connected to a separate circuit and is clearly identified. No other electrical systems of a project will be allowed in street lighting panels, unless otherwise approved by the Engineer.

Street lighting conduit in foundations shall be extended 3-inches above the bottom of the cabinet, or to within 6-inches of the hand hole for pole foundations. Conduit for service equipment ground rod conductors shall be 1/2-inch PVC Schedule 40 if buried or Schedule 80 if exposed.

When more than 1 street lighting circuit is contained in a conduit run, each load conductor shall have its own separate neutral. No "share" neutrals shall be permitted.

The Contractor shall extend street lighting circuit conduit and wire to junction boxes at the end of street extensions.

For metal poles with slip bases, a ground rod shall be installed in the concrete junction box at the pole. A separate 1-inch nonmetallic conduit with No. 6 AWG copper ground wire shall be installed from the pole base to the junction box and ground rod.

II.10.D.05.3 TRAFFIC SIGNAL CONDUIT, JUNCTION BOXES, CABLE, AND WIRE

Wire between pole or pedestal bases and terminating points, and control cable between signal spans and terminal cabinets shall be installed without splicing. Junction boxes shall not be used for splicing, except for loop wire splicing of loop wires to loop feeder cables.

Conduits for loop detector feeder cables from the soft pocket to the junction boxes shall be installed as per ODOT *Standard Specifications*.

Loop feeder cables shall be stripped back a minimum amount to facilitate connections, and shall be joined to loop wires with non-insulated pressure butt connectors. Loop conductor and connector shall be soldered using a non-flame heat source, then sealed with heat-shrink tubing.

Neutral conductors shall not be spliced in the junction boxes but shall be continued to terminals in the service cabinet.

II.10.D.06 PHOTOELECTRIC CONTROL RELAY

Street lighting systems shall be controlled by a single master photo electric (PE) cell per panel located on the pole nearest the panel. Control units may be mounted on either a special pole top fitting or on a receptacle on the luminaire housing.

Street lighting systems located at traffic signals shall be controlled by a single master photo electric (PE) cell per luminaire, and shall be located on top of the luminaire head. All photocells shall be mounted so that the light sensitive element's surface is oriented to the north sky. The date of installation shall be marked on the bottom of the photoelectric control with an indelible marking pen.

II.10.D.07 LAMPS, BALLASTS, AND LUMINARIES

All lamps, ballasts, and luminaries shall be installed according with the manufacturer's recommendations. The Contractor shall utilize all mounting holes to fasten the ballast securely within the luminaire. All noisy or defective ballasts shall be replaced at the Contractor's expense.

All lamps, ballasts and luminaries shall be cleaned thoroughly to remove all dirt, oil, and resins from all exposed surfaces immediately prior to installation. All labels and markings shall be removed with the exception of the UL label. Luminaries shall be wiped inside and out to remove construction dust and debris. Luminaire plastic lenses shall be cleaned with antistatic cleaners only.

All surfaces of luminaries and poles shall be painted as required using the specified matching paint ordered from the manufacturer.

II.10.D.08 TRAFFIC SIGNAL INDICATION MATERIAL, MOUNTING HARDWARE, AND DETECTION DEVICES

All mounting hardware and detection devices shall be ODOT approved, as listed in the Blue and Green sheets. Standard traffic signal heads shall be 1-way, 3-section heads, adjustable through 360° about a vertical axis, and designed for the method of mounting shown or specified. Heads shall be furnished complete, including lamps, lenses, LED modules, visors, reflectors, sockets, backboards, and mounting appurtenances. All lamps shall be LED.

LED traffic signal head retrofit kits in new or existing heads shall fit into all types of 12-inch traffic signal heads without the need to modify the head in any way.

Mounted vehicle signal heads shall be covered at all times until the signal installation is approved for continuous operation. The entire face of the signal head to the rim of the backboard shall be covered with burlap, canvas, cardboard, or other approved cover materials.

When shown or specified, audible pedestrian signals (APS) shall provide a unique sound coincidental with the WALK indication. The APS shall include a solid state electronic board(s), power supply, enclosure, loudspeaker, and mounting hardware necessary for fulfilling the intended use stated herein and in applicable portions of the ODOT *Standard Specifications for Microcomputer Signal Controller*.

Pedestrian push buttons shall be mounted on a pole, pedestal, or post whose foundation directly abuts as AC or PCC landing or walkway. Push buttons shall be equipped with an instructional sign having an arrow pointing to the crosswalk for which it is intended.

Saw cuts shall be at least 1/2-inch wide for loop wire and loop feeder cable. All saw cuts shall be made using a single blade of the width required for the saw cut in order to provide a smooth cut without ridges. Saw cuts shall not require greater than a 90° bend in loop wire.

No more than 4 loop wires shall be installed in a single saw cut. The Engineer may limit the allowable saw cut depth and width to avoid damage to the pavement.

For open-graded AC surfaces, saw cuts and installation shall be similar to ODOT Standard Drawing TM419 detail, "Loop Wire Installation in Base Lift (or After Grinding) Prior To Placement of Open-Graded Mix for Wearing Surface," except that detection devices shall be installed 5/8-inch deeper than shown on this drawing, and the loop sealant shall not completely fill the saw slot, but rather shall come up 1/2-inch to 5/8-inch from the AC surface.

A permanent plastic label shall be placed on each loop feeder cable with the loop numbers, in indelible ink, as shown on the Loop Detector Wiring Diagram. Labels shall be placed within 4-inches of the end of the jacket at each end of the loop feeder cables. At junction box locations where the loop wires are spliced to the loop feeder cable, the loop wires shall also be labeled. Clear heat shrink tubing shall be installed over the labels.

Loop wire shall be connected to loop feeder cable with a soldered-compression splice located in the junction box. Splices shall be offset to insure they do not make contact with each other. Splices shall be made by removing 4- to 6-inches of the feeder cable outer jacket, drain wire, and shield, without damaging the conductor insulation. Feeder and loop conductor cables shall be stripped back approximately 1/2-inch, and crimped with a seamless, non-insulated butt connector (3M® part #M14BCX or equivalent) of the proper size. Splices shall be soldered with 60/40 rosin-core solder using a soldering iron, gun, or flameless soldering torch. Open flame torches will not be allowed. Connections shall be sweated to ensure solder fills voids in the splice. All edges shall be smooth. The completed splice shall be covered with self-sealing shrink tubing (UL 486, 90°C, 600 V) constructed of homogeneous polyolefin and having an internally applied sealant. Heat-shrink tubing shall be used on individual wire splices and over the entire cable splice, with the tubing extended at least 1-inch beyond the ends of the insulation and/or inner heat-shrink tubing. Silicon sealant (Crafco Loop Detector Sealant or equivalent) shall be applied before shrinking the heat-shrink tubing. All loop feeder conductor terminations from field wiring in signal controller cabinets shall be soldered after crimp lugs have been installed. Crimp lugs used for loop wire field terminals may be insulated or uninsulated.

When installing the loop wires in the saw cuts, the Contractor shall use a 1/4-inch to 3/16-inch thick wood paddle or roller to push the wires in place. Metal objects, such as screwdrivers shall not be used. The Contractor shall allow enough loop wire for the run to the junction box plus an additional 5-feet of slack in the box. This wire, from loop to junction box, shall be twisted together 4 to 6 turns per foot prior to placement in the saw cut. There shall be no splices in the loop wires. Loop circuit pairs shall be identified and labeled as required in ODOT *Standard Specifications* Section 00990.43(b) (2). Loop pairs shall also be identified with start and end wire leads.

Splicing shall be done during dry weather and shall only be done in the junction boxes. Saw cut slots shall be filled in accordance to details shown on the plans. There shall be no more than 4 loop detector conductors (2 twisted paired) installed in 1 saw cut slot.

Minimum distances between lead-in saw cuts and any loop side or between lead-in saw cuts shall be 2-feet and 6-inches, respectively. Unless otherwise approved by the Engineer, detector loops shall be installed within 2 weeks after final asphalt lift has been placed, and before permanent pavement markings are installed.

Fire preemption systems shall: (a) include all required control modules, detector units, detector feeder cable, wiring harness, interface circuitry, and miscellaneous hardware; (b) have detector feeder cable of the type and size recommended by the supplier of the preemption equipment; and (c) have cable that runs continuously without splices from the detector unit to the controller cabinet.

Where interconnection to railroad circuits is shown or specified, the traffic signal cabinet shall be interconnected with the railroad cabinet. The railroad company will furnish 2 sets of contacts in the railroad cabinet that will open upon actuation of the track circuit by a train. The interconnect circuit will operate as a “fail-safe” device which will cause an actuation if power to the track circuit is interrupted.

II.10.E.00 TESTING

This section covers the work and materials necessary for testing existing and new traffic signals and street lighting structures and sub-structures as shown or directed. All materials and work shall conform to the requirements of the ODOT *Standard Specifications*, Part 00900 and supporting sections, and ODOT/APWA Standard Drawing numbers BR-900 through BR-993 and numbers TM100 through TM565, as directed by the Engineer, or as modified herein.

If the inspection reveals any defects in the work or unsatisfactory work, such defects shall be repaired or replaced, as directed by the Engineer. All materials furnished and installed shall be satisfactory as determined by the Engineer after testing, repair, and any necessary re-testing prior to acceptance. The cost of any additional materials or labor necessary to successfully complete the test, with the exception of electrical energy, shall be at the Contractor’s expense.

The Contractor shall be responsible for loss or damage to any work and equipment which occurs during performance of the contract without additional cost to the City. Damaged standards or assemblies shall be replaced except where minor damage may be repaired, as approved by the Engineer.

The Contractor shall provide 2 copies of all required test results identifying observed readings with their respective circuits to the City. The tests shall be performed in the presence of the Engineer of Record.

Approval of the street lighting or traffic signal system, in writing by the City, constitutes final acceptance on the date of such approval. The final acceptance date marks the beginning of the required 1 year warranty period. Final acceptance does not constitute acceptance of any unauthorized or defective work, or material. Final acceptance will not be given until accurate, approved As-Builts have been provided to the City, as specified under Section II.10.C.02.1.b of these Standards. As-Built

drawings shall be kept by the Contractor as the work progresses, and shall be kept current and show all changes and deviations from the contract drawings.

II.10.E.01 STREET LIGHTING FIELD TESTING AND FINAL ACCEPTANCE

Prior to completion of the work, the Contractor shall perform the following tests on all electrical circuits: (a) Examine grounds in each circuit to ensure that all required ground jumpers, devices and appurtenances do exist and are mechanically firm, meeting the requirements of Article 250 of the National Electrical Code; (b) Test and record all readings on each circuit between the phase conductor and ground with all switchboards, panel boards, fuse holders, switches, receptacles, and over-current devices in place; (c) Megger test with all wiring installed but not connected to luminaire ballasts, photoelectric relays, and contactor coils.

After the lighting system has been installed and energized, and prior to final acceptance, the system shall be operated for a minimum of 7 consecutive days under normal conditions (i.e. off during the day, on at night) with continuous satisfactory operation for the entire street lighting system. The Contractor shall notify the Engineer 48 hours in advance of the start of the 7 day test.

II.10.E.02 TRAFFIC SIGNAL FIELD TESTING AND FINAL ACCEPTANCE

Prior to completion of the work, the Contractor shall perform the following tests on all electrical circuits: (a) each loop circuit shall be tested for continuity with resistance readings not to exceed .5 ohms; and (b) the resistance test between each circuit and ground shall be checked using a 500 V Megger tester both before placing the sealant and after the sealant has set, and shall not be less than 1 gigohm.

The traffic control program shall be furnished by the Contractor to the City prior to final acceptance.

After the traffic signal system has been installed and energized, and prior to final acceptance, the system shall be operated continuously for a minimum of 7 consecutive days with satisfactory operation for the entire traffic signal system. Tests shall not start on a Friday, or on any day preceding a legal holiday. The Contractor shall notify the Engineer 48 hours in advance of the start of the 7 day test.

II.10.F.00 MEASUREMENT AND PAYMENT

II.10.F.01 MEASUREMENT

When specified, measurement of traffic signals and street lighting systems will be on a lump sum basis.

No measurement of quantities will be made for this work. If plan changes are ordered, or the field-verified pole or arm lengths increase or decrease for lighting poles and arms, adjustments will be made according to City regulations. The estimated quantities of lighting poles and arms will be listed in the Special Provisions for the purpose of providing a basis for adjustment. No adjustment in the Contract lump sum amount will be made, except as provided above.

II.10.F.02 PAYMENT

II.10.F.02.1 GENERAL

Payment for the following listed items which may appear in the bid Proposal, and for other bid items which may become applicable to traffic signal and street lighting system, shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials, and incidentals necessary for all of the Contract work as specified under or covered by this Section.

When neither specified or listed in the Proposal for separate payment, and all work specified for performance under or covered by this Section will be considered as incidental work for which no separate payment will be made.

Partial payment shall be made based on the percentage of total work completed, up to 50% of the specified bid lump sum. The remaining 50% payment shall be made upon completion and final acceptance of the work.

II.10.F.02.2 PAY ITEMS

Pay Item Description	Unit of Measure
Removal of Existing Street Lighting System	LS
Removal of Existing Traffic Signal System	LS
Removal and Replacement of Street Lighting System	LS
Removal and Replacement of Traffic Signal System	LS
Installation of Street Lighting System	LS
Installation of Traffic Signal System	LS

X:\Divisions\Engineering\Capital Planning&Projects\Standards\Construction Specifications\04 Update\Written Spec\Street.wpd